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The impact of a lung cancer computed tomography screening result on smoking abstinence

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ABSTRACT: Receiving a lung cancer computed tomography screening result might be a teachable moment for smoking cessation, but it might also unintentionally reassure smokers to continue smoking. The objective of the present study was to investigate whether test results were associated with smoking abstinence in the Dutch–Belgian Randomised Controlled Lung Cancer Screening Trial (NELSON trial).

Two random samples of male smokers who had received either only negative test results (n=550) or one or more indeterminate test result (n=440) were sent a questionnaire 2 yrs after randomisation.

Smokers with an indeterminate result reported more quit attempts (p=0.02), but the prolonged abstinence rate in smokers receiving a negative test (46 (8.9%) out of 519 subjects) was comparable with the abstinence rate in smokers with one or more indeterminate results (48 (11.5%) out of 419 subjects) (p=0.19). A statistically insignificant increase was found after one or more indeterminate test result (10.9 and 15.0%, respectively) compared with receiving only negative test results (8.9%) (p=0.26).

In conclusion, the outcome of the screening test had no impact on future smoking abstinence in male smokers, although all results suggest more favourable implications after one or more follow-up recommendations. Screening test outcomes could be used as a teachable moment for smoking cessation.

KEYWORDS: Lung cancer screening, prevention and control, smoking behaviour

Lung cancer, the leading cause of cancer deaths, is often diagnosed at an advanced stage and occurs increasingly amongst former smokers [1], which underlines the need for preventive measures. Several randomised screening trials are evaluating the (cost-)effectiveness of lung cancer computed tomography (CT) screening in reducing lung cancer mortality [2, 3].

Even though the population eligible for lung cancer screening usually has a long-term smoking history [4], significant health benefits might be achieved by smoking cessation, even in this high-risk population [5, 6]. However, resistance to quitting smoking is high in this population [7] and this group of smokers is often under-represented in smoking cessation interventions [8].

Healthcare events, such as receiving an abnormal test result or an unfavourable medical diagnosis, might be teachable moments that increase the motivation to quit smoking [8–11]. So far, there is no strong evidence that people at high risk for lung cancer who receive an abnormal lung cancer screening test result will be more prone to quit smoking than those with a normal test result or *vice versa*. A single baseline CT test result appeared to have no impact on smoking abstinence rates or change in smoking behaviour in studies by ANDERSON *et al.* [12], COX *et al.* [13], OSTROFF *et al.* [14] and TAYLOR *et al.* [15]. In contrast, the number of multiple abnormal lung cancer screening test results was positively associated with smoking cessation in the Mayo Clinic trial after 3 yrs of follow-up [16]. ASHRAF *et al.* [17] and STYN *et al.* [18] also found a higher quit rate after a positive test result or referral to a physician, and OSTROFF *et al.* [14] concluded that participation in lung cancer screening programmes had a major impact on smoking behavioural changes, and that participants were convinced of the health benefits of smoking cessation.

In most lung cancer CT screening trials, the number of subjects with a positive test result that

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require referral for work-up and diagnosis is high [13–16]. In the Dutch–Belgian Randomised Controlled Lung Cancer Screening Trial (NELSON trial), we used a novel strategy for the management of lung nodules [3]. After an indeterminate test result, a recall CT scan to assess nodule growth was introduced. This new approach led to a substantial reduction in the number of positive tests and, therefore, fewer referrals to the pulmonologist for work-up, without losing significant diagnostic performance [3]. This novel strategy might also have a different effect on smoking behaviour changes compared with the current nodule management algorithms. Therefore, our objective in the present study was to investigate whether the CT screening test result (negative *versus* indeterminate) was related to future smoking abstinence amongst 50–75-yr-old male smokers who participated in the NELSON trial. In addition, we investigated whether the number of indeterminate screening test results was associated with an increased quit rate and aimed to identify baseline characteristics associated with prolonged smoking abstinence after 2 yrs of follow-up.

MATERIALS AND METHODS

Study population

NELSON trial

The recruitment and selection procedure of the NELSON study participants has been described previously [19]. In summary, based on population registries, 15,822 eligible people aged 50–75 yrs, who signed the informed consent, were randomised to the screen or control arm (1:1) in two recruitment rounds. Participants eligible for the NELSON trial were current or former smokers who had smoked >15 cigarettes a day for >25 yrs or >10 cigarettes a day for >30 yrs. Former smokers should have quit smoking for ⩽10 yrs.

Participants in the screening arm underwent screening by low-dose, multidetector CT in years 1, 2 and 4, and no screening was offered to control arm participants. The screening results were either positive, indeterminate or negative according to our nodule management strategy [3]. A positive test result was classified as: 1) a solid nodule with a volume >500 mm^3; 2) a solid, pleural-based nodule with a diameter >10 mm; or 3) partially solid, of which the solid component measured >500 mm^3. An indeterminate test result was classified as: 1) a solid nodule with a volume of 50–500 mm^3; 2) a solid, pleural-based nodule with a diameter of 5–10 mm; 3) a partially solid nodule with either a nonsolid component of >8 mm mean dimension or a solid component of 50–500 mm^3; or 4) a nonsolid nodule with a diameter of ⩾8 mm. In all other cases, the test result was negative. People with a positive screening result were informed about their referral to a pulmonologist by phone, whereas those with either an indeterminate or a negative screening result received only a standard letter explaining that radiologists had or had not found an abnormality. An indeterminate screening result was not classified as a positive screening result, because participants with an indeterminate test result received a letter which was formulated very carefully to avoid possible psychological consequences often reported after a (false-)positive test result. The letter stated: ''We have observed a very small abnormality in your lung (5–10 mm long). Such a small abnormality is often detected in many persons and it usually represents a small scar or a minor inflammation. Therefore, at this moment there is no need for any further investigations. However, in order to see whether there has been any change in this abnormality, a new CT scan of the lungs will be made after 3 to 4 months.''

Smoking cessation information from STIVORO, the Dutch expert centre on tobacco control, was sent to all current smokers at randomisation. Current smokers received a standard brochure with brief information about how to quit smoking or a questionnaire for tailored smoking cessation information.

The NELSON trial was approved by the Ministry of Health, Welfare and Sports after positive advice of the Dutch Health Council, and by the Medical Ethics Committees of the participating centres.

Effect of a CT screening result on smoking cessation

The current study was conducted in a random subcohort of two samples of male screening arm participants who were current smokers before randomisation and were randomised in the NELSON trial during the first recruitment round. Participants who had smoked in the 7 days before completing the general questionnaire before randomisation (T0) were classified as current smoker. The random samples included only participants who had received either only negative test results (''test negatives''; n=550) or at least one indeterminate test result followed by a recommendation for recall CT screening after 3 months (''test indeterminates''; n=440). Male screening arm participants with a positive test result at follow-up (n=53, 2.1%) or those who went off-study (because of, for example. unavailability, personal reasons, lung cancer or death; n=163, 6.3%) were excluded from these samples.

The selected population received a second questionnaire about their actual smoking habits mean$\pm$SD 2.2$\pm$0.29 yrs after trial randomisation (T1) and 1.8$\pm$0.35 yrs after receiving their baseline test result (fig. 1). At follow-up, the test negative group had undergone 2$\pm$0.25 (only regular-round) CT scans and the test indeterminate group 3$\pm$0.47 (including regular and recall scans) CT scans.

Measures

T0: baseline questionnaire

Participants were asked about their age, sex and level of education. Their smoking history was assessed using questions about: age of smoking onset (8-point scale); average number of cigarettes smoked a day during the years of smoking (10-point scale); and the years of smoking during their lifetime (9-point scale) [19]. The last two variables were recoded into variables with five and four categories, respectively, and into a continuous variable based on the mean value of each category. The intention of quitting smoking was adapted from the Transtheoretical Model and classified according to the stages of change [20, 21]. Respondents who had no intention to quit smoking in the near future were defined as immotives, whereas contemplators, pre-contemplators and preparators reported an intention to quit smoking within 6–12 months, 1–6 months or 1 month, respectively [20, 21]. Nicotine addiction was estimated using the first question of the Fagerström Test for Nicotine Dependence (FTND), which asked for the time to the first cigarette after waking up (<5, 5–30, 30–60 or >60 min) [21, 22].

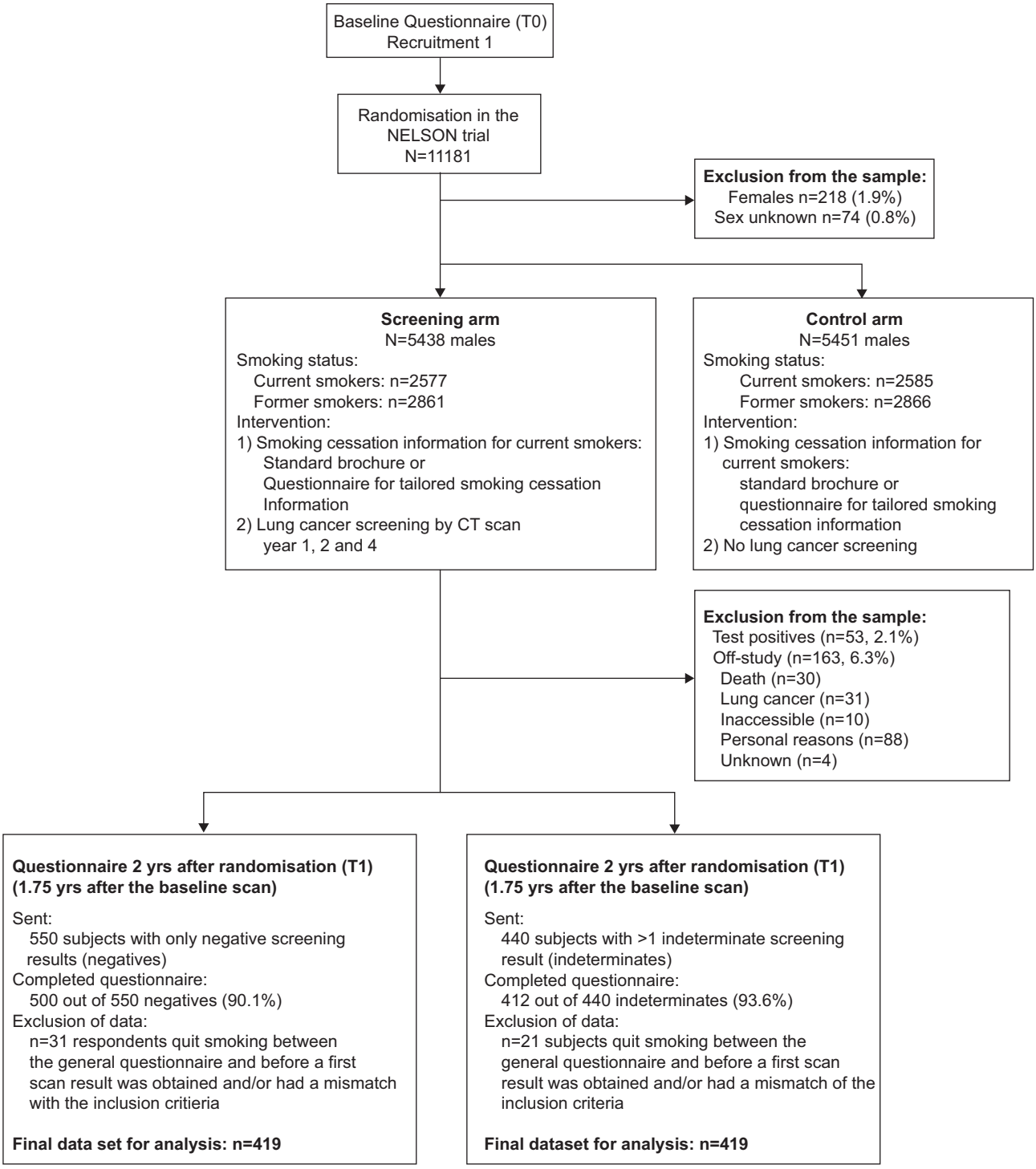

FIGURE 1. Study flowchart. NELSON: Dutch–Belgian Randomised Controlled Lung Cancer Screening Trial; CT: computed tomography.

T1: smoking cessation questionnaire

The second questionnaire included additional questions about the smoking habits at 2 yrs of follow-up. Current smoking behaviour was measured by asking the participants whether they usually smoked (yes/no), whether they had smoked during the previous 24 h (yes/no) and/or 7 days (yes/no). Respondents who reported smoking and/or who had smoked in the previous week were defined as current smokers, whereas others were defined as point prevalent abstinent from smoking [23].

To measure smoking abstinence, participants were asked about the number of quit attempts in the last year and whether they were engaged in a quit attempt at that time (yes/no). Former

smokers were asked about the date of quitting smoking (day/month/year) and whether they had smoked (not at all, 1–5 cigarettes or >5 cigarettes) since the quit date and 2 weeks after the quit date [23, 24]. Former smokers who had smoked <5 cigarettes since the quit date were classified as continued smoking abstinent, while former smokers who had smoked <5 cigarettes 2 weeks after their quit date were defined as prolonged smoking abstinent. Those who smoked >5 cigarettes were classified as current smokers [23, 24]. The smoking intensity at T1 was recoded into the categories of the number of cigarettes smoked at T0 (least precise). The transition through these categories was calculated and classified as stable, reduced smoking (lower category) or increased smoking intensity (higher category).

Statistical analysis

In order to detect an expected quit rate of 5–7% amongst smokers in the test negative group and 20% amongst smokers in the test indeterminate group [16, 25] with a power of 100%, the required sample size enrolled in each group was 400 participants.

Continuous variables with a normal distribution are presented as mean±SD and skewed continuous variables are presented as median (interquartile range).

The differences in distributions of baseline characteristics between male smokers of the first recruitment and the subgroups, between the two subgroups and between the respondents and nonrespondents of each subgroup were analysed using Pearson's Chi-squared test for nominal or categorical variables and the Mann–Whitney U-test for continuous variables with a non-normal distribution. The nonrespondents were classified as current smoker and included in the analysis [24].

Differences between former smokers in the negative and indeterminate group were analysed using the Mann–Whitney U-test, unpaired t-test or Chi-squared statistics as appropriate. The effect of the screening result on prolonged smoking abstinence was analysed using both univariate as well as multivariate unadjusted backward stepwise logistic regression analyses using the likelihood ratio test. The variables related to the test results, level of education, motivation to quit smoking and the time to the first cigarette (FTND) were included as categorical variables, while the other variables were included as continuous variables.

Results with a p-value $\leqslant 0.05$ were defined as statistically significant. The power analysis was calculated using the statistical software package R (The R Project, Institute for Statistics and Mathematics, Vienna University of Economics and Business, Vienna, Austria). The remaining statistics were performed using the SPSS statistical software package version 15.0 (IBM, Somers, NY, USA).

RESULTS

Characteristics of the participants

The response rates to the questionnaires were 90.9% (500 out of 550 subjects) and 93.6% (412 out of 440 subjects) for those who received only negative test results and those who received at least one indeterminate test result, respectively (fig. 1). 52 participants were excluded from all further analyses either because they had quit smoking between completion of the general questionnaire before randomisation and their first CT screening test result (n=31, 3.1%) or because of a mismatch with the inclusion criteria (male current smokers at randomisation) (n=21, 2.1%). The response was higher in the negative group compared with the indeterminate group (7.5 *versus* 4.3%; p=0.04), although there was no nonresponse bias (p>0.05).

The baseline characteristics of the subsamples were representative for the male smokers of the first recruitment of the NELSON trial and the participants of both groups were comparable with regard to baseline characteristics (no statistically significant differences) (table 1). Mean±SD age was 57.9±5.0 and 58.9±4.9 yrs in the test negative and indeterminate group, respectively. A total of 49.0% (249 out of 508) of the test negatives and 53.7% (220 out of 410) of the test indeterminates had a low level of education. Participants with and without a follow-up recommendation had a comparable smoking history between 30–60 pack-yrs (60.7% (315 out of 519) *versus* 59.6% (249 out of 418), respectively). 70% (362 out of 519) of the test negatives and 62.3% (261 out of 419) of the test indeterminates started smoking between 15–20 years of age, and 58.6% of the test negatives and 61.8% of the test indeterminates reported an intention to quit smoking. A high level of nicotine addiction was reported in 17.9% (88 out of 492) of the test negatives and 22.8% (90 out of 395) of the test indeterminates (p=0.04), as estimated by subjects smoking their first cigarette within 5 min after waking up.

Screening test results and smoking abstinence

After 2 yrs of follow-up, smokers who received only negative test results had made fewer quit attempts compared with smokers who received at least one follow-up recommendation (1.5±2.0 *versus* 1.9±2.7 attempts; p=0.016).

No statistically significant differences were found in smoking abstinence rates between the test negative and test indeterminate group. Point prevalence of smoking abstinence was reported in 54 (10.4%) out of 519 and 51 (12.2%) out of 419 subjects (p=0.39), prolonged smoking abstinence in 46 (8.9%) out of 519 and 48 (11.5%) out of 419 subjects (p=0.19), and continued abstinence in 46 (8.9%) out of 519 and 47 (11.2%) out of 419 subjects (p=0.23) in the negative and indeterminate groups, respectively (table 2). Prolonged abstinence rates slightly increased with an increased number of indeterminate test results, from 46 (8.9%) out of 519 subjects after only negative test results to 39 (10.9%) out of 359 subjects after one indeterminate result, and to nine (15%) out of 60 subjects after two or more indeterminate test results, but this did not reach statistical significance (p=0.26) (fig. 2).

Former smokers had quit smoking for 9.0±10.9 and 7.6±11.0 months in the test negative and indeterminate groups, respectively (p=0.30). The time frame between receiving the last regular test result and the quit date was also comparable for both groups (7.0±4.2 and 6.7±3.8 months, respectively; p=0.74) (table 2).

Furthermore, we found comparable smoking habits among test negatives and test indeterminates who still smoked after 2 yrs of follow-up (p=0.37) (table 2). After multivariate testing, only

TABLE 1 Baseline characteristics of the participants of the Dutch–Belgian Randomised Controlled Lung Cancer Screening Trial (NELSON trial) and the respondents of the subcohort[#]

	Male smokers randomised in the screening arm	Smoking cessation questionnaire respondents		
		Total[¶]	Test negatives	Test indeterminates
Age yrs	58.0±4.9	58.0±5.0	57.9±5.0	58.6±4.9
Level of education				
Low	1223/2532 (48.3)	463/928 (49.9)	249/508 (49.0)	220/410 (53.7)
Medium	615/2532 (24.3)	222/928 (23.9)	122/508 (24.0)	97/410 (23.7)
High	694/2532 (27.4)	227/863 (26.2)	137/508 (27.0)	93/410 (22.6)
Cigarettes per day				
⩽15	673/2576 (26.1)	280/948 (29.5)	154/519 (29.7)	121/419 (28.9)
16–20	701/2576 (27.2)	248/948 (26.2)	132/519 (25.4)	123/419 (29.4)
21–25	696/2576 (27.0)	256/948 (27.0)	145/519 (27.9)	97/419 (23.2)
>25	506/2576 (19.6)	164/948 (17.3)	88/519 (17.0)	78/419 (18.5)
Smoking duration yrs				
⩽35	669/2575 (26.0)	236/948 (24.9)	131/519 (25.2)	99/418 (23.7)
36–40	874/2575 (33.9)	330/948 (34.8)	183/519 (35.3)	138/418 (33.0)
41–45	726/2575 (28.2)	269/948 (28.4)	144/519 (27.7)	130/418 (31.1)
>45	306/2575 (11.9)	112/948 (11.8)	61/519 (11.8)	51/418 (12.2)
Smoking exposure pack-yrs				
⩽30	766/2575 (29.7)	297/948 (31.3)	163/519 (31.4)	130/418 (31.1)
31–40	729/2575 (28.3)	280/948 (29.5)	153/519 (29.5)	124/418 (29.7)
41–50	586/2575 (22.1)	194/948 (20.5)	106/519 (20.4)	87/418 (20.8)
51–60	277/2575 (10.8)	99/948 (10.5)	56/519 (10.8)	38/418 (9.1)
>60	235/2575 (9.1)	77/948 (8.2)	41/519 (7.9)	39/418 (9.3)
Starting age of smoking yrs				
<15	437/2575 (17.0)	148/948 (15.6)	78/519 (15.0)	76/419 (18.1)
15–20	1665/2575 (64.7)	648/948 (68.4)	362/519 (69.7)	261/419 (62.3)
>20	473/2575 (18.4)	152/948 (16.0)	79/519 (15.2)	82/419 (15.2)
Time to the first cigarette[+] min				
<5	484/2442 (19.8)	169/898 (18.8)	88/492 (17.9)	90/395 (22.8)
5–30	983/2442 (40.3)	350/898 (39.0)	190/492 (38.6)	160/395 (40.5)
30–60	617/2442 (25.3)	245/898 (27.3)	140/492 (28.5)	89/395 (22.5)
>60	358/2442 (14.7)	134/898 (14.9)	74/492 (15.0)	56/395 (14.2)
Motivation to quit smoking				
Immotive	993/2485 (40.0)	374/918 (40.8)	208/503 (41.4)	154/403 (38.2)
Pre-contemplator	388/2485 (15.6)	134/918 (14.6)	74/503 (14.7)	57/403 (14.1)
Contemplator	759/2485 (30.5)	279/918 (39.4)	148/503 (29.4)	140/403 (34.8)
Preparator	345/2485 (13.9)	130/918 (14.2)	73/503 (14.5)	52/403 (12.9)

Data are presented as mean±SD or n/N (%). Test negatives: male smokers who received only negative test results; test indeterminates: male smokers who received at least one indeterminate test result. Low educational level: primary, lower secondary general or lower vocational education; medium educational level: intermediate vocational education or higher secondary education; high educational level: higher vocational education or university. Immotive: no intention to stop smoking within 1 yr or later; pre-contemplator: intention to stop smoking within 6–12 months; contemplator: intention to stop smoking within 1–6 months; preparator: intention to stop smoking within the next month. [#]: no selection and/or nonresponse bias was found ($p>0.05$); [¶]: data are weighted to correct for the actual distribution of negative and indeterminate screening results in the screening arm; [+]: first question of the Fagerström Test for Nicotine Dependence.

the addiction to nicotine predicted the prolonged abstinence from smoking significantly ($p=0.006$) (table 3).

DISCUSSION

The results of our study demonstrated that the lung cancer screening test result (negative or indeterminate) had no statistically significant impact on future smoking abstinence amongst male smokers randomised in the NELSON trial. Nevertheless, all outcome parameters were more favourable for smokers who received at least one indeterminate test result, with a nonsignificant increased quit rate after multiple follow-up recommendations.

The findings are supported by the studies of ANDERSON *et al.* [12], COX *et al.* [13], OSTROFF *et al.* [14] and TAYLOR *et al.* [15], who demonstrated no statistically significant impact of the test result on smoking cessation. The small, but insignificant, increase in the abstinence rates after multiple indeterminate

TABLE 2 Smoking behaviour of male smokers who received either only negative screening results (negatives) or at least one indeterminate screening result (indeterminates)

	Test negatives	Subjects n/N	Test indeterminates	Subjects n/N	p-value
Quit attempts	1.5±2.0	376	1.9±2.7	312	0.016
Point prevalence of smoking abstinence					0.39
Continued smoking	89.6	465/519	87.8	368/419	
Smoking abstinence	10.4	54/519	12.2	51/419	
Prolonged smoking abstinence					0.19
Continued smoking	91.1	473/519	88.5	371/419	
Prolonged abstinence	8.9	46/519	11.5	48/419	
Continued smoking abstinence					0.23
Continued smoking	91.1	473/519	88.8	371/419	
Continued abstinence	8.9	47/519	11.2	48/419	
Follow-up period after quit date# months	9.0 (10.9)	40	7.6 (11.0)	40	0.30
Time between last regular screening result and quit date# months	7.0±4.2	40	6.7±3.8	40	0.74
Time between baseline scan and quit date# months	12.3±7.2	40	13.4±7.8	40	0.50
Last scan before quit date#					0.50
Scan round year 1	50.0	20/40	42.5	17/40	
Scan round year 2	50.0	20/40	57.5	23/40	
Cigarettes per day¶	20 (13)	434	20 (12)	353	0.37
Reduced smoking¶					
Increased smoking	18.4	80/434	14.7	52/353	
No change	29.7	129/434	30.3	107/353	
Reduced smoking	51.8	225/434	55.0	194/353	

Data are presented as mean±SD, % or median (interquartile range), unless otherwise stated. Test negatives: male smokers who received only negative test results; test indeterminates: male smokers who received at least one indeterminate test result. #: results are based on data for former smokers with complete data of quit date. ¶: results are based on data from respondents who smoked at follow-up.

test results was more or less in line with TOWNSEND *et al.* [16], who found a positive association between the number of follow-up recommendations and the smoking abstinence rate. It is expected that this nonsignificant higher quit rate in test indeterminates is a result of the teachable moment of the follow-up procedure. It should be noted that the majority of the smokers who received one or more indeterminate test results also received one or more negative test result during follow-up, which might underestimate the impact of an indeterminate test result as a teachable moment. That aside, we found that, although the overall quit rate amongst all participants of the NELSON trial was higher than we could expect from the quit rate in the general adult population, the proportion of smoker in the control arm who quit smoking was modest, but statistically significantly ($p<0.05$) higher compared with screen arm participants after logistic regression analysis. This raised some concern that lung cancer screening might have a health certificate effect [26]. This means that lung cancer screening might give some participants an unrealistic feeling of reassurance, which leads to continued smoking or even smoking relapse (licence to smoke). From the present study, we cannot conclude whether the outcome of the test is related to smoking relapse. We expected only a limited effect, because ANDERSON *et al.* [12] reported no increase in smoking relapse after consecutive negative test results compared with referral to the pulmonologist.

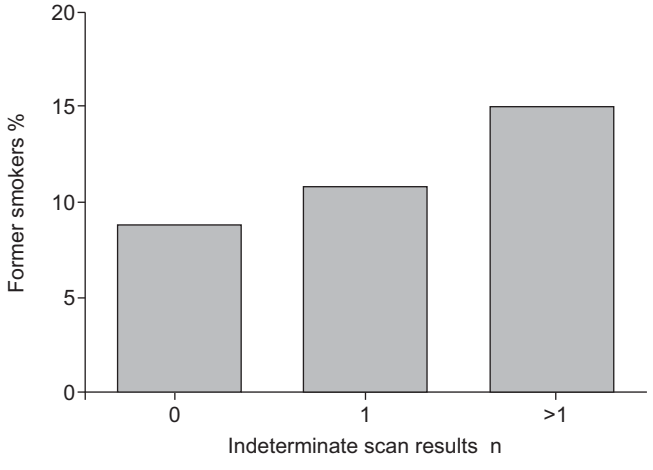

FIGURE 2. Quit rates of male smokers in relation to the number of indeterminate screening result(s) after 2 yrs of follow-up (Chi-squared 2.704, degrees of freedom 2; n=938; p=0.26).

A combined approach for both primary and secondary prevention efforts to optimise cancer control is a relatively new research area, and evidence-based guidelines have yet to be published. More research is needed to investigate the opportunities for lung cancer screening in current, as well as former, smokers in order to promote health risk-reducing behaviour change and to prevent relapses [27], and to

TABLE 3 The univariate and multivariate predictors of prolonged smoking abstinence

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Test result				
Only negative	1.00			
⩾1 indeterminate	1.33 (0.87–2.04)	0.19		
Test result in the previous 12 months				
Negative	1.00			
Indeterminate	1.26 (0.48–3.30)	0.64		
Age	1.02 (0.98–1.07)	0.31		
Level of education				
Low	1.00	0.09		
Medium	1.14 (0.65–1.98)	0.65		
High	1.73 (1.06–2.84)	**0.029**		
Cigarettes per day	0.99 (0.96–1.02)	0.40		
Smoking duration yrs	1.01 (0.97–1.05)	0.58		
Starting age yrs				
<15	1.00	0.09		
15–20	1.70 (0.88–3.29)	0.12		
>20	0.95 (0.40–2.27)	0.91		
Time to first cigarette min				
<5	1.00	**0.005**	1.00	**0.006**
5–30	1.99 (0.96–4.09)	0.06	1.94 (0.94–4.00)	0.08
30–60	1.26 (0.56–2.85)	0.58	1.28 (0.56–2.89)	0.56
>60	3.42 (1.56–7.51)	**0.002**	3.39 (1.55–7.45)	**0.002**
Motivation to quit smoking				
Immotive	1.00	0.55		
Pre-contemplator	0.80 (0.38–1.66)	0.55		
Contemplator	1.25 (0.75–2.07)	0.39		
Preparator	1.32 (0.69–2.51)	0.40		

Low educational level: primary, lower secondary general or lower vocational education; medium educational level: intermediate vocational education or higher secondary education; high educational level: higher vocational education or university. Immotive: no intention to stop smoking within 1 yr or later; pre-contemplator: intention to stop smoking within 6–12 months; contemplator: intention to stop smoking within 1–6 months; preparator: intention to stop smoking within the next month. Bold indicates statistical significance.

investigate what the most cost-effective approach is in this screening population.

When interpreting our results, several limitations of the present study should be considered. First, people with a positive test result were excluded from this sample, because of the low prevalence of positive test results in the screening arm (2.6%) as a result of our NELSON nodule management strategy. An indeterminate test result combined with a recommendation for a recall CT scan as a teachable moment is expected to be less powerful compared with a positive test result, because referral to a pulmonologist for work-up and diagnosis might have more impact on smoking habits compared with receiving our letter with a recommendation for a recall CT scan. This might explain the different outcome of our study compared with the results of STYN *et al.* [18], who compared those who were referred because of an abnormal CT screening result with those who were test negative.

Another limitation is that our results were restricted to male smokers, because of the low proportion of females in the NELSON trial (16%). Although there is no evidence that the impact of participation in a lung cancer screening on smoking behaviour is sex-dependent [13, 16–17], our results can only be generalised to male smokers who have undergone CT screening for lung cancer until there is more evidence that CT screening for lung cancer will have no different impact on smoking habits amongst females.

The data were also based on self-completed questionnaires without the biochemical verification of smoking status. This may introduce a social response bias that could affect the impact of CT screening on smoking habits, although it is unlikely that this bias would differ according to screening result. We also assume a limited risk of social response bias since a valid self-reported smoking status was found in a lung cancer screening programme [28]. Therefore, our participants were screened for lung cancer instead of participating in a trial that investigated the impact of a smoking cessation intervention. Nevertheless, we would recommend further investigation of whether self-reported smoking behaviour is valid and reliable amongst participants of a lung cancer screening trial.

Finally, our results were based on a small sample of current smokers only with the aim of limiting all possible interventions, besides CT screening for lung cancer, in the first year of the trial. The difference in observed smoking abstinence was substantially lower, so that a significant difference could have been missed due to small sample size. Retrospectively, the required sample size for each group to detect the observed quit rates should be 2,500 for a power of 80%.

In conclusion, the outcome of the screening test had no statistically significant impact on future smoking abstinence in male smokers, although all results suggests more favourable implications after one or more follow-up recommendation. Lung cancer screening test outcomes might provide a teachable moment for smoking cessation.

STATEMENT OF INTEREST

None declared.

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