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The impact of a lung cancer CT screening result on smoking abstinence.

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Abstract

Receiving a lung cancer CT screening result might be a teachable moment for smoking cessation, but it might also unintentionally reassure smokers to continue smoking.

The objective was to investigate whether the test result was 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 two years after randomization.

Smokers with an indeterminate result reported more quit attempts (p=0.02), but the prolonged abstinence rate in smokers receiving a negative test (8.9%; 46/519) was comparable with the abstinence rate in smokers with one or more indeterminate results (11.5%; 48/419) (p=0.19). A statistically insignificant increase was found after one or >1 indeterminate test results (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 suggests more favourable implications after one or more follow-up recommendations. Screening test outcomes could be used as a teachable moment for smoking cessation.

Introduction

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 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 quit smoking is high in this population (7) and this group of smokers is often underrepresented in smoking cessation interventions (8).

Health care events such as receiving an abnormal test result or an unfavourable medical diagnosis might be a teachable moment that increases 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 COX *et al.*, TAYLOR *et al.*, OSTROFF *et al.*, and ANDERSON *et al.* (12-15). In contracts, the number of multiple abnormal lung cancer screening test results was positively associated with smoking cessation in the Mayo Clinic trial after three years of follow-up (16) ASHRAF *et al.* and STYN *et al.* (17-18) 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 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). An indeterminate test result, followed by a recall CT-scan to assess nodule growth, was introduced. This new approach led to a substantial reduction in the number of test positives and therefore less 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 was to investigate whether the CT screening test result (test negative versus test indeterminate) was related to future smoking abstinence amongst 50-75 year 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 to identify baseline characteristics associated with prolonged smoking abstinence after two years of follow-up.

Materials and Methods

Study population

NELSON trial

The recruitment and selection procedure of the NELSON study participants has been described before (19). In summary, based on population registries, 15,822 eligible people aged between 50-75 years, 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 have smoked at least >15 cigarettes a day for >25 years or >10 cigarettes a day for >30 years. Former smokers should have quit smoking for ≤ 10 years.

Participants in the screen arm underwent screening by low-dose multi-detector CT in year one, two and four 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 by 1) a solid nodule with a volume >500mm^3, 2) a solid, pleural-based nodule with a diameter >10 mm or 3) partially solid of which the solid component measured >500mm^3. An indeterminate test result was classified by 1) a solid nodule with a volume between 50-500 mm^3, 2) a solid, pleural-based nodule with a diameter between 5-10 mm, 3) a partially solid nodule with either a non-solid component of > 8 mm mean dimension or a solid component of 50-500 mm3, or 4) a non-solid 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 is 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 a 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 sub cohort of two samples of male screen arm participants who were current smokers before randomisation and who were randomised in the NELSON trial during the first recruitment round. Participants who had smoked in the seven days before completing the general questionnaire before randomization (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 three months ("*test indeterminates*") (n=440). Male screen arm participants with a positive test result at follow-up (n=53, 2.1%), or those who went off-study (because of e.g. 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 on average 2.2 (SD 0.29) years after trial randomisation (T1) and 1.8 years (SD 0.35) after receiving their baseline test result (Fig. 1). At follow-up, the test negative group had undergone 2 (SD 0.25) (only regular round CT scans) and the test indeterminate group 3 (SD 0.47) (including regular and recall scans) CT scans.

Measures

Baseline questionnaire (T0)

Participants were asked about their age, gender and level of education. Their smoking history was assessed by questions about the age of smoking onset (8-point scale); the 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 a variable with 5 and 4 categories respectively and into a continuous variable based on the mean value of each category. The intention to quit 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 next 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 one month, respectively (20-21). Nicotine addiction was estimated by the first question of the Fagerström Test for Nicotine Dependence (FTND) that asked for the time to the first cigarette after waking up (<5 minutes, 5-30 minutes, 30-60 minutes or >60 minutes) (21-22).

Smoking cessation questionnaire (T1)

The second questionnaire included additional questions about the smoking habits at two years of follow-up. Current smoking behaviour was measured by asking the participants whether they smoked usually (yes/no), whether they had smoked during the previous 24 hours (yes/no) and/ or seven days (yes/no). Respondents who reported to smoke 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 attempt last years and whether they were engaged in a quit attempt at that moment (yes/no). Former smokers were asked about the date of quitting smoking (day/month/year) and whether they had smoked (not al all, 1-5 cigarettes, >5 cigarettes) since the quit date and since two 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 since two weeks after their quit date were defined as prolonged smoking abstinent. Those who smoked >5 cigarettes were classified as current smoker (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

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 100%, the required sample size enrolled in each group was 400 participants.

Continuous variables with a normal distribution were presented as mean ± SD, whereas skewed continuous variables were 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 non-respondents of each subgroup, were analyzed using Pearson's Chi-square for nominal or categorical variables and the Mann-Whitney-U test for continuous variables with a non-normal distribution. The non-respondents were classified as current smoker and included in the analysis (24).

Differences between former smokers in the negative and indeterminate group were analyzed using the Mann-Whitney-U test, unpaired samples T test, or Chi-square statistics as appropriate. The effect of the screening result on prolonged smoking abstinence was analyzed 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 variable, while the other variables were included as continuous variables..

Results with a p-value ≤0.05 were defined as statistically significant. The power analysis was calculated using the statistical software package R. The remaining statistics were performed using the SPSS statistical software package version 15.0.

Results

Characteristics of the participants

The responses to the questionnaires were 90.9% (500/550) and 93.6% (412/440) for those who received only negative test results and those who received at least one indeterminate test result, respectively (Fig. 1). Fifty-two participants were excluded from all further analysis, 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 randomization) (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 non-response bias (p>0.05).

The baseline characteristics of the sub samples 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 the baseline characteristics (no statistically significant differences) (Table 1). Mean age was 57.9 ± 5.0 and 58.9 ± 4.9 years in the test negative and indeterminate group, respectively. A total of 49.0% (249/508) of the test negatives and 53.7% (220/410) 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-years (60.7% (315/519) versus 59.6% (249/418), respectively). Seventy percent (362/519) of the test negatives and 62.3% (261/419) 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% (88/492) of the test negatives and 22.8% (90/395) of the test

indeterminates (p=0.04), as estimated by smoking the first cigarette within five minutes after waking-up.

Screening test results and smoking abstinence

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

No statistically differences were found in smoking abstinence rates between the test negative and test indeterminate group. Point prevalence of smoking abstinence was reported in 10.4% (54/519) and 12.2% (51/419) (p=0.39), prolonged smoking abstinence in 8.9% (46/519) and 11.5% (48/419) (p=0.19), and continued abstinence in 8.9% (46/519) and 11.2% (47/419) (p=0.23) in the negative and indeterminate group, respectively (Table 2). Prolonged abstinence rates slightly increased with an increased number of indeterminate test results, from 8.9% (46/519) after only negative test results to 10.9% (39/359) after one indeterminate result, to 16.1% (9/60) after two or more indeterminate test results, but this did not reach statistical significant differences (p=0.26) (Fig. 2).

Former smokers had quit smoking since 9.0 (10.9) and 7.6 (11.0) months in the test negative and indeterminate group respectively (p=0.30). The time frames between receiving the last regular test result and the quit date was also comparable for both groups (7.0 ± 4.2 months 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 years of follow-up (p=0.37) (Table 2). After

multivariate testing, only 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 different 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 non-significant increased quit rate after multiple follow-up recommendations.

The findings are supported by the studies of COX *et al.,* TAYLOR *et al.,* OSTROFF *et al.,* and ANDERSON *et al.* (12-15), 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 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 non-significant higher quit rate in test indeterminates is a result of the teachable moment of the follow-up procedure. We should realize that the majority of the smokers who received one or more indeterminate test results also received one or more negative test results during follow-up, which might underestimate the impact of an indeterminate test result as a teachable moment. Apart from that, 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

smokers in the control arm were modest, but statistically significant ($p<0.05$) more likely to quit smoking 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 (license to smoke). From the current 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. reported no increase in smoking relapse after consecutive negative test results compared with referral to the pulmonologist (12).

A combined approach for both primary as well as secondary prevention efforts to optimize cancer control is a relative new research area and evidence based guidelines have not been published so far. More research is needed to investigate the opportunities of lung cancer screening in current as well as former smokers to promote health risk-reducing behaviour change and to prevent relapses (27) and to investigate what the most cost-effective approach is in this screening population.

In interpreting our results, one should be aware of several limitations of this study. First, people with a positive test result were excluded from this sample, because of the low prevalence of positive test results in the screen 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 a 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 women in the NELSON trial (16%). Although there is no evidence that the impact of participation in a lung cancer screening on the smoking behaviour is gender dependent (13, 16-17), our results can only be generalized to male smokers who underwent 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 women.

The data were also based on self-completed questionnaires without the biochemical verification of the smoking status. This may always introduce social response bias that may affect the impact of CT screening on smoking habits, although it is unlikely that this bias would differ by 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). Thereby, our participants were screened for lung cancer in stead of that they participate in a trial that investigate the impact of a smoking cessation intervention. Nevertheless, it would be recommended to further investigate whether the self-reported smoking behaviour amongst participants of a lung cancer screening trial is valid and reliable.

Finally, our results were based on a small sample of only current smokers with the aim to limit 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 2500 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 recommendations. Lung cancer screening test outcomes indeed might have opportunities to be a teachable moment for smoking cessation.

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TABLE 1 Baseline characteristics of the participants of the NELSON trial and the respondents of the sub-cohort.[1]

	Male smokers randomised in the screen arm of the NELSON trial (1st recruitment)	**Male smokers responded to the smoking cessation questionnaire**		
		Total [2]	***Test Negatives***	***Test Indeterminates***
Age	58.0 ± 4.9	58.0± 5.0	57.9 ± 5.0	58.6 ± 4.9
Level of education				
Low educational level	48.3 (1223/2532)	49.9 (463/928)	49.0 (249/508)	53.7 (220/410)
Medium educational level	24.3 (615/2532)	23.9 (222/928)	24.0 (122/508)	23.7 (97/410)
High educational level	27.4 (694/2532)	26.2 (227/863)	27.0 (137/508)	22.6 (93/410)
Number of cigarettes a day				
≤ 15 cigarettes	26.1 (673/2576)	29.5 (280/948)	29.7 (154/519)	28.9 (121/419)
16-20 cigarettes	27.2 (701/2576)	26.2 (248/948)	25.4 (132/519)	29.4 (123/419)
21-25 cigarettes	27.0 (696/2576)	27.0 (256/948)	27.9 (145/519)	23.2 (97/419)
> 25 cigarettes	19.6 (506/2576)	17.3 (164/948)	17.0 (88/519)	18.5 (78/419)
Smoking duration				
≤ 35 years	26.0 (669/2575)	24.9 (236/948)	25.2 (131/519)	23.7 (99/418)
36-40 years	33.9 (874/2575)	34.8 (330/948)	35.3 (183/519)	33.0 (138/418)
41-45 years	28.2 (726/2575)	28.4 (269/948)	27.7 (144/519)	31.1 (130/418)
> 45 years	11.9 (306/2575)	11.8 (112/948)	11.8 (61/519)	12.2 (51/418)
Pack-years				
≤ 30 pack-years	29.7 (766/2575)	31.3 (297/948)	31.4 (163/519)	31.1 (130/418)
31-40 pack-years	28.3 (729/2575)	29.5 (280/948)	29.5 (153/519)	29.7 (124/418)
41-50 pack-years	22.1 (586/2575)	20.5 (194/948)	20.4 (106/519)	20.8 (87/418)
51-60 pack-years	10.8 (277/2575)	10.5 (99/948)	10.8 (56/519)	9.1 (38/418)
> 60 pack-years	9.1 (235/2575)	8.2 (77/948)	7.9 (41/519)	9.3 (39/418)
Starting age of smoking				
< 15 years	17.0 (437/2575)	15.6 (148/948)	15.0 (78/519)	18.1 (76/419)
15-20 years	64.7 (1665/2575)	68.4 (648/948)	69.7 (362/519)	62.3 (261/419)
> 20 years	18.4 (473/2575)	16.0 (152/948)	15.2 (79/519)	19.6 (82/419)
Time to the first cigarette[3]				
< 5 minutes	19.8 (484/2442)	18.8 (169/898)	17.9 (88/492)	22.8 (90/395)
5 - 30 minutes	40.3 (983/2442)	39.0 (350/898)	38.6 (190/492)	40.5 (160/395)
30 minutes -1 hour	25.3 (617/2442)	27.3 (245/898)	28.5 (140/492)	22.5 (89/395)
> 1 hour	14.7 (358/2442)	14.9 (134/898)	15.0 (74/492)	14.2 (56/395)
Motivation to quit smoking				
Immotive	40.0 (993//2485)	40.8 (374/918)	41.4 (208/503)	38.2 (154/403)
Precontemplator	15.6 (388//2485)	14.6 (134/918)	14.7 (74/503)	14.1 (57/403)
Contemplator	30.5 (759//2485)	39.4 (279/918)	29.4 (148/503)	34.8 (140/403)
Preparator	13.9 (345/2485)	14.2 (130/918)	14.5 (73/503)	12.9 (52/403)

Data were presented as % (n/N), mean ± sd, unless stated otherwise.

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 indicates 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 indicates no intention to stop smoking within 1 year or later; precontemplator, intention to stop smoking within 6-12 months; contemplator, intention to stop smoking within 1-6 months; prepartor, intention to stop smoking within the next month

[1] No selection and/or non-response bias was found ($p > 0.05$).
[2] Data is weighted to correct for the actual distribution of negative and indeterminate screening results in the screen arm.
[3] First question of the Fagerström Test for Nicotine Dependence (FTND).

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

	Test Negatives	*n*	**Test Indeterminates**	*n*	***p-value***
Number of 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 smoking 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 smoking abstinence	8.9	*46/519*	11.2	*48/419*	
Follow-up period after quit date[1]					
Median (IQR) (in months)	9.0 (10.9)	*40*	7.6 (11.0)	*40*	*0.30*
Time between last regular screening result and quit date[1] Mean (SD) (in months)	7.0 ± 4.2	*40*	6.7 ± 3.8	*40*	*0.74*
Time between baseline scan and quit date[1]					*0.50*
Mean (SD) (in months)	12.3 ± 7.2	*40*	13.4 ± 7.8	*40*	
Last scan round before quit date[1]					*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*	
Number of cigarettes a day[2]		434		*353*	*0.37*
Median (IQR)	20 (13)		20 (12)		
Reduced smoking[2]					
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*	

Negatives indicates the group participants who received only negative screening results; Indeterminates indicates the group participants who received at least one indeterminate screening result, NA not applicable.

Data were presented as % (n/N), mean ± sd, or median (interquartile range), unless stated otherwise.

[1] The results are based on data of former smokers with complete data of the quit date.

[2] The results are based on data of respondents who smoked at follow-up.

TABLE 3 The univariate and multivariate predictors of prolonged smoking abstinence.

	Univariate analysis			Multivariate analysis		
	Exp(B)	**95%-CI**	**Sig.**	**Exp(B)**	**95%-CI**	**Sig.**
Test result						
Only negative test results	1.00					
≥ 1 indeterminate test result	1.33	(0.87 - 2.04)	0.19			
Test result in the last 12 months						
Negative test result	1.00					
Indeterminate test result	1.26	(0.48 - 3.30)	0.64			
Age	1.02	(0.98 - 1.07)	0.31			
Level of education						
Low educational level	1.00		0.09			
Medium educational level	1.14	(0.65 - 1.98)	0.65			
High educational level	1.73	(1.06 - 2.84)	**0.029**			
Cigarettes smoked a day	0.99	(0.96 - 1.02)	0.40			
Smoking duration (years)	1.01	(0.97 - 1.05)	0.58			
Starting age						
< 15 years	1.00		0.09			
15 - 20 years	1.70	(0.88 - 3.29)	0.12			
> 20 years	0.95	(0.40 - 2.27)	0.91			
Time to the first cigarette						
< 5 minutes	1.00		**0.005**	1.00		**0.006**
5 - 30 minutes	1.99	(0.96 - 4.09)	0.06	1.94	(0.94 – 4.00)	0.08
30 - 60 minutes	1.26	(0.56 - 2.85)	0.58	1.28	(0.56 – 2.89)	0.56
> 60 minutes	3.42	(1.56 - 7.51)	**0.002**	3.39	(1.55 – 7.45)	**0.002**
Intention to stop smoking (T0)						
Immotive	1.00		0.55			
Precontemplator	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 indicates 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 indicates no intention to stop smoking within one year or later; precontemplator, intention to stop smoking within 6-12 months; contemplator, intention to stop smoking within 1-6 months; prepartor, intention to stop smoking within the next month

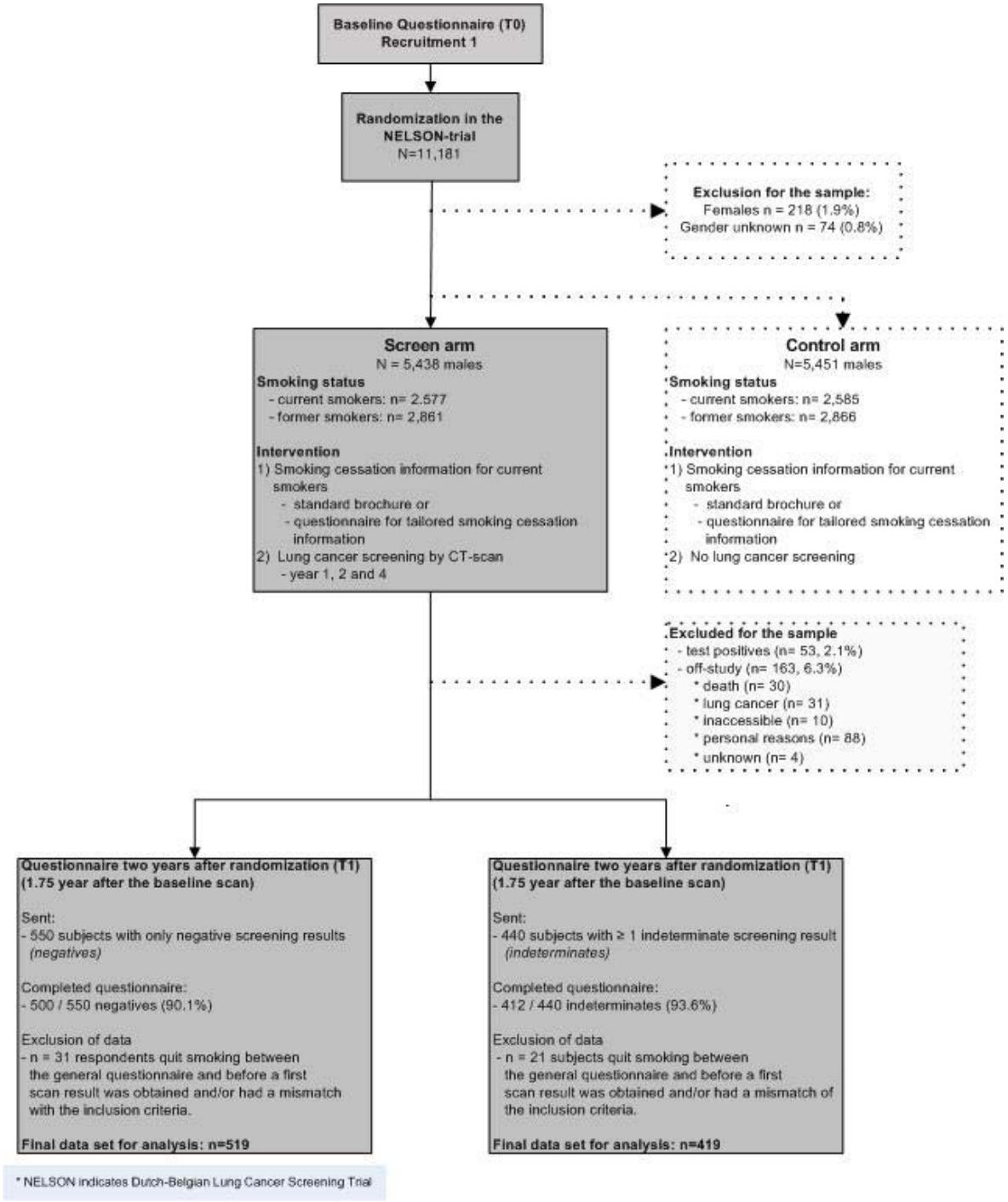

Figure 1. Study flowchart

Figure 2. The quit rates of male smokers in relation to the number of indeterminate screening result(s) after two years of follow-up.