Annals of Internal Medicine ORIGINAL RESEARCH

Gradual Versus Abrupt Smoking Cessation

A Randomized, Controlled Noninferiority Trial

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Background: Most smoking cessation guidelines advise quitting abruptly. However, many quit attempts involve gradual cessation. If gradual cessation is as successful, smokers can be advised to quit either way.

Objective: To examine the success of quitting smoking by gradual compared with abrupt quitting.

Design: Randomized, controlled noninferiority trial. (International Standardized Randomized Controlled Trial Number Register: ISRCTN22526020)

Setting: Primary care clinics in England.

Participants: 697 adult smokers with tobacco addiction.

Intervention: Participants quit smoking abruptly or reduced smoking gradually by 75% in the 2 weeks before quitting. Both groups received behavioral support from nurses and used nicotine replacement before and after quit day.

Measurements: The primary outcome measure was prolonged validated abstinence from smoking 4 weeks after quit day. The secondary outcome was prolonged, validated, 6-month abstinence.

Results: At 4 weeks, 39.2% (95% CI, 34.0% to 44.4%) of the participants in the gradual-cessation group were abstinent compared with 49.0% (CI, 43.8% to 54.2%) in the abrupt-cessation group (relative risk, 0.80 [CI, 0.66 to 0.93]). At 6 months, 15.5% (CI, 12.0% to 19.7%) of the participants in the gradual-cessation group were abstinent compared with 22.0% (CI, 18.0% to 26.6%) in the abrupt-cessation group (relative risk, 0.71 [CI, 0.46 to 0.91]). Participants who preferred gradual cessation were significantly less likely to be abstinent at 4 weeks than those who preferred abrupt cessation (38.3% vs 52.2%; $P = 0.007$).

Limitations: Blinding was impossible. Most participants were white.

Conclusion: Quitting smoking abruptly is more likely to lead to lasting abstinence than cutting down first, even for smokers who initially prefer to quit by gradual reduction.

Primary Funding Source: British Heart Foundation.

Ann Intern Med. 2016;164:585-592. doi:10.7326/M14-2805 **www.annals.org**
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This article was published at www.annals.org on 15 March 2016.

Conventionally, smokers are advised to quit abruptly by setting a quit day to stop smoking in 1 step. Worldwide guidelines for smoking cessation generally recommend abrupt cessation and do not support a gradual reduction in smoking (1–3); however, many smokers report stopping gradually (4–6). It is important to know whether gradual cessation has a lower success rate so physicians can provide evidence-based advice.

Evidence on whether gradual cessation is less effective than abrupt cessation conflicts. Observational data on quit attempts made primarily without behavioral support suggest that stopping abruptly is superior (4, 7). However, a Cochrane review of 10 randomized trials (8) suggests that the difference in quit rates achieved using the 2 approaches is slight, with a relative risk (RR) of 0.94 (95% CI, 0.79 to 1.13). Several trials included in the review had design features that make it difficult to discern whether the differences in quit rates were solely due to the method used to achieve abstinence. None were designed to assess noninferiority, and the pooled 95% CI obtained encompasses a substantial reduction in the efficacy of gradual compared with abrupt quitting. We conducted a large trial to test whether an initial gradual reduction in smoking results in noninferior quit rates compared with abrupt cessation.

Methods

Design

We randomly assigned adult smokers to gradually reduce tobacco use over 2 weeks before a planned quit day (gradual-cessation group) or to stop smoking abruptly on a planned quit day (abrupt-cessation group). The gradual-cessation group received short-acting nicotine replacement therapy (NRT) and nicotine patches before the quit day. The abrupt-cessation group received only nicotine patches before the quit day. Both groups had behavioral counseling, nicotine patches, and short-acting NRT after the quit day. Our primary outcome was validated abstinence 4 weeks after the quit day. We also evaluated 6-month abstinence and whether outcomes differed according to participants' preferred method of quitting.

Participants

We recruited adult smokers who were addicted to tobacco, defined as those who smoked at least 15 cigarettes or 12.5 grams of loose-leaf tobacco daily or who had an end-expiratory carbon monoxide (CO) concentration of at least 15 ppm. Participants had to be willing to quit smoking 2 weeks after trial enrollment. Exclusion criteria included current participation in cessation treatment, contraindications to NRT, participation in other medical trials, and circumstances precluding the ability to meet the demands of the trial. Persons who were dependent on alcohol or illicit drugs or who had

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Context

Patients may vary in their expressed preferences about how to stop smoking cigarettes. Whether an initial gradual reduction in cigarette use before an attempt at quitting is as effective as abrupt cessation is not known.

Contribution

In this trial, adult smokers randomly assigned to gradually reduce smoking before a planned quit date were less likely to achieve abstinence than those who quit abruptly.

Implication

Abrupt cessation of smoking is more likely to lead to sustained abstinence.

severe acute or chronic medical or psychiatric conditions were included unless their conditions were so severe that it was unlikely that they would be able to meet the demands of the trial.

The lead general practitioner at 31 volunteer practices in England searched their electronic patient records and wrote to all registered patients who smoked to invite them to the study. Potential participants were encouraged to call the researchers who explained the trial and screened patients for eligibility. Eligible smokers were booked for an appointment with a research nurse during which the study was explained, eligibility was confirmed, and written informed consent was obtained.

Interventions

Participants were asked to set a quit day 2 weeks after enrollment, and the intervention differed between groups only during these weeks. In the gradual-cessation group, participants aimed to reduce smoking to half of the baseline amount by the end of the first week (known as visit −1) and to a quarter of the baseline amount at the end of the second week (visit 0) in daily increments. Reduction over 2 weeks was chosen because qualitative evidence suggests that this keeps persons more focused on quitting than longer reduction (9), data from a trial support this approach (10), and the 2-week reduction before quit day is current practice in the United Kingdom. (11). Participants in the gradual-cessation group chose 1 of the following 3 structured reduction programs: scheduled (1, 12), hierarchical, or smoke-free periods (**Appendix**, available at www.annals.org).

The nurse created reduction schedules with the participants to boost understanding and memory and discussed strategies to prompt adherence. Smoking reduction is more successful when participants use NRT (13), so we provided the gradual-cessation group with nicotine patches, 21 mg/d, and a choice of short-acting NRT products (gum, lozenges, nasal spray, sublingual tablets, inhalator, or mouth spray) during the reduction period. For such products as gum and lozenges, the instruction was to use 1 dose per cigarette missed.

Participants in the abrupt-cessation group were asked to smoke as normal and not reduce between the baseline appointment and quit date. To balance the behavioral support time, participants identified the times of day when cigarettes would be the hardest to give up and planned strategies to avoid relapse after the quit day. Before quitting, participants in the abrupt-cessation group were asked to use nicotine patches, 21 mg/d, but no short-acting NRT. Nicotine patches were used in this group before the quit day because some evidence suggests that precessation NRT increases quit rates, and this protocol aimed to balance the effect between groups (14).

Other than these differences, the treatment program in both groups was identical. Participants were seen by a research nurse at their primary care practice weekly for 2 weeks before their quit day (baseline and visit −1), the day before their quit day (visit 0), weekly for 4 weeks after quitting (visits 1 through 4), and finally 8 weeks after the quit day (visit 8). The behavioral support for both groups from visit 0 onward was withdrawal-oriented therapy, which is typical of a smoking cessation clinic in the United Kingdom (12, 15). Withdrawal-oriented therapy focuses on the commitment to abstain completely and provides support early, which is when withdrawal symptoms are worst and relapse is most likely. Pharmacotherapy was identical in both groups from the quit day onward and consisted of a nicotine patch, 21 mg/d, plus short-acting NRT of the participant's choice. Participants were encouraged to use their NRT liberally in anticipation of or in response to cravings.

Randomization

Participants were randomly assigned in a 1:1 ratio to gradual or abrupt cessation at the baseline visit. An independent statistician used Stata, version 10.1 (StataCorp), to accomplish randomization stratified by research nurse, with randomly ordered blocks of 2, 4, and 6 to ensure balance. After the participant granted consent, the research nurse opened sealed, numbered envelopes in turn. For pairs (for example, husband and wife), one person was allocated randomly and the other was allocated to the same group.

Measures

Participant demographic characteristics, smoking history, nicotine dependence, and preference for gradual or abrupt cessation were recorded at baseline. At each subsequent clinic session, we assessed the amount smoked and measured salivary cotinine and exhaled CO concentrations. Tobacco withdrawal symptoms were also measured using the mood and physical symptoms scale, which we present here as the mean scores for urge intensity and withdrawal symptoms (16). We also assessed adverse events, and participants rated the severity of possible symptoms of nicotine overdose during the 2-week (prequit day) period of NRT and concurrent smoking. Nicotine overdose symptoms were provided as a checklist, and participants

were asked, "Have you been troubled by any of the following problems in the past 24 hours?" They rated each symptom on a scale ranging from "not at all" to "extremely." All participants were asked to complete daily diaries in the 2 weeks before quit day to measure adherence to medication and behavioral instructions. Trial group preference was reassessed at 4-week follow-up.

The primary outcome was Russell Standard 4-week abstinence. The Russell Standard allows a 2-week grace period from quit day for slips and uses an intention-to-treat approach that assumes that persons lost to follow-up are smokers. Russell Standard abstinence is validated by an exhaled CO concentration of less than 10 ppm (17). Secondary outcomes were Russell Standard abstinence at 8-week and 6-month follow-up; 7-day point prevalence abstinence at 4-week, 8-week, and 6-month follow-up, validated by an exhaled CO concentration of less than 10 ppm; and urges to smoke and nicotine withdrawal symptoms at 1- and 4-week follow-up.

Statistical Analysis

Our chosen noninferiority margin was equal to an RR of 0.81 or a 19% reduction in the effectiveness of quitting gradually compared with abruptly. This is an absolute difference in quit rates of 9.5 percentage points at 4 weeks, assuming a 50% quit rate in the abrupt-cessation group (18). Using a 1-sided α of 5%, we needed 343 participants per group to have 80% power to detect this difference in the primary outcome.

In the abstinence analysis, we present RRs because of the high incidence of abstinence (>10%). The primary noninferiority analysis (abstinence at 4 weeks) was based on a 1-sided α of 0.05, and therefore a 90% CI was calculated. In accordance with CONSORT (Consolidated Standards of Reporting Trials) (17), we interpreted this CI in relation to our predetermined noninferiority margin (RR, 0.81). To assess superiority, which is also advised in noninferiority trials (19), we calculated RRs with 95% CIs. All RRs (noninferiority and superiority) were estimated using marginal standardization via logistic regression (20) and were adjusted for nurses. Confidence intervals were calculated via percentile bootstrapping. These analyses were carried out by using the prLogisticBootMarg (prLogistic package) in R (R Foundation for Statistical Computing).

When couples were recruited, we randomly assigned 1 member of the couple and nonrandomly allocated the other to the same group. We then conducted a sensitivity analysis, excluding the member who was nonrandomly assigned.

We calculated the proportion of participants attending each of the 2 postbaseline visits before quit day (visits −1 and 0) and compared these proportions by group using a chi-square test with Yates correction for the difference between proportions. Medication use before quit day was assessed and reported as the percentage of persons using a patch daily, whether short-acting NRT was used, and the number of units of short-acting NRT used daily. Data on both smoking reduction (cigarettes smoked per day and CO concentration) and medication use were taken from the daily diary, and participants without these data were excluded from the analysis.

For all participants, the mean scores for urge intensity and withdrawal symptoms were calculated (at baseline and weeks 1 and 4) by using their responses to the 2 urge-related questions and 7 withdrawal-related questions of the mood and physical symptoms scale, respectively. We used a linear generalized estimating equation (xtgee command in STATA) to explore differences in the mean scores of urge intensity and withdrawal symptoms across weeks 1 through 4 and adjusted for the nurse providing treatment and repeated measures. Participants missing scores at all 3 time points were excluded from this analysis, but otherwise all participants were included in the model.

We compared 4-week abstinence between participants preferring to quit gradually, those preferring to quit abruptly, and those with no preference. Using logistic regression with the same marginal standardization as for other abstinence outcomes, we analyzed the effect of allocation to gradual cessation on 4-week abstinence and stratified the following preferences by baseline: prefer gradual cessation, prefer abrupt cessation, or no preference.

Approvals

The study and protocol were authorized by the Nottingham Research Ethics Committee 2 (08/H0408/213), the Medicines & Healthcare Products Regulatory Agency, and local National Health Service Research & Development offices. Further, the study was registered before participant enrollment (ISRCTN22526020).

Role of the Funding Source

Funding was provided by the British Heart Foundation (PG/08/047/25082). The funder was not involved in the analysis of the data or the interpretation of the findings and had no role in writing the manuscript or submitting it for publication.

RESULTS

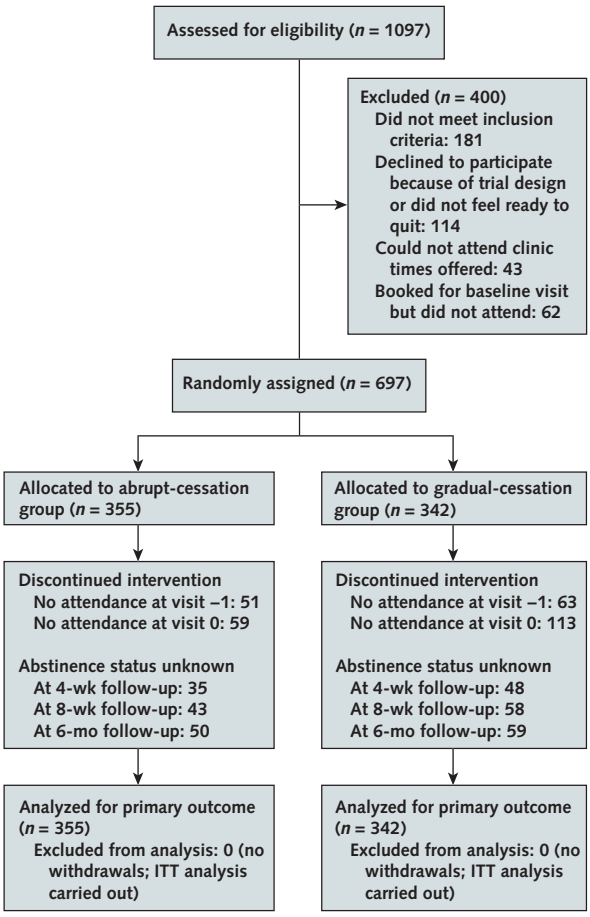
Recruitment

Of 1097 persons enquiring, 697 were randomly assigned (355 to the abrupt-cessation group and 342 to the gradual-cessation group) by 23 nurses across 31 primary care practices between June 2009 and December 2011 (Figure 1).

Baseline Characteristics

Participant characteristics were well-balanced between trial groups (Table 1). Participants were on average aged 49 years; were equally split between men and women; had smoked 20 cigarettes daily; and had a Fagerström Test for Cigarette Dependence score of 6 (21), which indicates high dependence. Most participants (94%) described their ethnicity as "white."

Figure 1. Study flow diagram.



ITT = intention-to-treat.

Abstinence Rates

The primary outcome, 4-week Russell Standard abstinence, was achieved by 39.2% (CI, 34.0% to 44.4%) of the gradual-cessation group and 49.0% (CI, 43.8% to 54.2%) of the abrupt-cessation group. Noninferiority was not shown (unadjusted RR, 0.80 [90% CI, 0.68 to 0.96]). But at 4 weeks, achieving abstinence was significantly less likely in the gradual-cessation group than in the abrupt-cessation group (adjusted RR, 0.80 [95% CI, 0.66 to 0.93]). The risk estimates for secondary outcomes, including 6-month prolonged abstinence and point prevalence abstinence, also indicated superiority of abrupt over gradual cessation (Table 2). Excluding the second member of a couple gave similar RRs for abstinence at 4 weeks and 6 months (data not shown).

Visit Attendance and Adherence

Similar percentages of participants in both groups attended visit −1 (82% [279 of 342 participants] of the gradual-cessation group and 85.6% [304 of 355] of the abrupt-cessation group; $P = 0.147$). However, significantly fewer participants in the gradual-cessation group attended visit 0, which was immediately before the quit day (67.0% [229 of 342] vs. 83.4% [296 of 355] in the abrupt-cessation group; $P < 0.001$). Fewer participants made a quit attempt (≥24 hours of self-reported abstinence) in the gradual-cessation group (61.4% [210 of 342]) than the abrupt-cessation group (71% [252 of 355]) ($P = 0.007$) (Table 2). Relapse rates were similar in both groups at 4-week follow-up (36.2% [76 of 210] in the gradual-cessation group vs. 31.0% [78 of 252] in the abrupt-cessation group; $P = 0.28$) and 6-month follow-up (74.8% [157 of 210] vs. 69.1% [174 of 252]; $P = 0.21$).

Participants in the gradual-cessation group had reduced their cigarette consumption by an average of 48% (target of 50%) at visit −1 ($n = 264$) and by 68% (target of 75%) at visit 0 ($n = 184$). Exhaled CO concentration had been reduced by 32% at visit −1 ($n = 275$) and 46% at visit 0 ($n = 226$). We also noted modest reductions in cigarette use (29% [$n = 237$]) and exhaled CO (18% [$n = 291$]) in the abrupt-cessation group at visit 0 (Figure 2).

Medication adherence was generally good. Of participants who attended visit –1, 81.4% (227 of 279 participants) in the gradual-cessation group and 89.5% (272 of 304) in the abrupt-cessation group used their nicotine patch daily in the first week. Of participants who attended visit 0, 87.3% (200 of 229) in the gradual-cessation group and 89.2% (264 of 296) in the abrupt-cessation group used their nicotine patch daily in the second week. Only participants in the gradual-cessation group were provided with short-acting NRT for the prequit weeks. In the first week, 76.0% (212 of 279) used their NRT; in the second week, 76.0% (174 of 229) did so. Of the participants who used short-acting NRT, 84% (225 of 279) chose gum, lozenges, or sublingual tablets. Although the instruction was to replace each missed cigarette with 1 dose of these products, the mean dose was 2.8 (SD, 3.1) units per day in the first week (on average, participants reduced their smoking by 11 cigarettes per day) and 4.7 (SD, 3.9) units per day in the second week (average reduction of 15 cigarettes per day). In the remaining participants who used short-acting NRT, the dose of inhalator and nasal spray used was similarly low.

Postquit Urges and Withdrawal Symptoms

For all participants, withdrawal symptoms and urge intensity scores were available on at least 1 assessment for 692 (99.3%) and 695 (99.7%) participants, respectively. Over 4 weeks, there was no evidence of a difference between groups in withdrawal symptoms or urge intensity (withdrawal symptoms, $P = 0.29$; urge intensity, $P = 0.154$), both of which declined over time. At week 4, there were no significant differences between groups in withdrawal symptoms (mean difference, 0.08 [CI, −0.03 to 0.19]) and urge intensity (mean difference, 0.05 [CI, −0.06 to 0.17]) scores.

Intervention Preference

At baseline, 16.9% ($n = 118$) of participants had no preference with regard to intervention assignment; 32.1% ($n = 224$) would have chosen abrupt cessation, and 50.9% ($n = 355$) would have chosen gradual cessa-

Table 1. Baseline Participant Characteristics*

Characteristic	All (*n* = 697)	Gradual-Cessation Group (*n* = 342)	Abrupt-Cessation Group (*n* = 355)
Median age (IQR), *y*	49.0 (40.0–57.0)	49.0 (39.8–57.0)	49.0 (40.0–57.0)
Male	350/697 (50.2)	175/342 (51.2)	175/355 (49.3)
White ethnicity	648/692 (93.6)	319/341 (93.5)	329/351 (93.7)
Postsecondary school (aged 15–16 y) educational qualification	345/678 (50.9)	160/330 (48.5)	185/348 (53.2)
In paid employment	382/691 (55.3)	190/340 (55.9)	192/351 (54.7)
Median age started smoking (IQR), *y*	16.0 (14.0–18.0)	16.0 (15.0–18.0)	16.0 (14.0–18.0)
Lives with smoker	266/688 (38.7)	116/335 (34.6)	150/353 (42.5)
Median previous quit attempts (IQR), *n*	2.0 (1.0–3.0)	2.0 (1.0–3.0)	2.0 (1.0–4.0)
Type of cigarettes smoked			
Manufactured	530/697 (76.0)	266/342 (77.8)	264/355 (74.4)
Hand-rolled	137/697 (19.7)	61/342 (17.8)	76/355 (21.4)
Both	30/697 (4.3)	15/342 (4.4)	15/355 (4.2)
Median cigarettes per day (IQR), *n*	20.0 (15.0–25.0)	20.0 (15.0–25.0)	20.0 (16.0–25.0)
Median expired CO concentration (IQR), *ppm*	24.0 (17.0–31.0)	24.0 (17.0–31.0)	24.0 (17.5–31.0)
Median salivary cotinine concentration (IQR), *nmol/L*	2036.3 (1475.2–2659.9)	2074.9 (1452.1–2807.5)	1985.2 (1441.0–2564.0)
Median FTCD score (IQR)†	6.0 (4.0–7.0)	6.0 (4.0–7.0)	6.0 (4.0–7.0)
Preference			
Abrupt-cessation group	224/697 (32.1)	107/342 (31.3)	117/355 (33.0)
Gradual-cessation group	355/697 (50.9)	179/342 (52.3)	176/355 (49.6)
No preference	118/697 (16.9)	56/342 (16.4)	62/355 (17.5)
Median confidence in quitting (IQR)‡	4.0 (4.0–5.0)	4.0 (4.0–5.0)	4.0 (4.0–5.0)

CO = carbon monoxide; FTCD = Fagerström Test for Cigarette Dependence; IQR = interquartile range.
* Values are numbers/totals (percentages) unless otherwise indicated. Numbers of participants used to calculate statistics for each variable vary slightly in some cases because of missing data (denominators provided). Percentages may not sum to 100 due to rounding.
† From 0–10, where 10 indicates the highest level of dependence.
‡ Measured on a scale from 1–6, where 1 indicates very low and 6 indicates extremely high.

tion. Participants who preferred gradual cessation were significantly less likely to be abstinent at 4 weeks than those who preferred abrupt cessation (38.3% vs 52.2%; $P = 0.007$). Among those who preferred gradual cessation and were allocated to quit abruptly against their preference, abstinence at 4 weeks was 42.0% compared with 34.6% among those assigned to gradual cessation (not statistically different; $P = 0.152$). The RRs for achieving abstinence for the gradual-cessation group compared with the abrupt-cessation group, stratified by baseline preference, were as follows: prefer gradual cessation, 0.82 (CI, 0.64 to 1.07); no preference, 0.80 (CI, 0.49 to 1.07); and prefer abrupt cessation, 0.79 (CI, 0.60 to 1.08) (Table 3). Of all participants who did not achieve abstinence at 4 weeks, 61% (112 of 184 participants) said they would prefer to quit by gradual cessation in a future quit attempt (Appendix).

Adverse Events

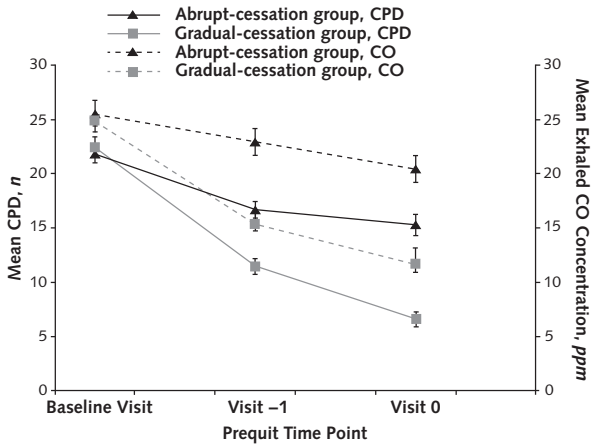
None of the serious adverse events reported were deemed a reaction to the trial medication. Three serious adverse events in the gradual-cessation group (shoulder arthroscopy, hospitalization due to salivary gland calculus, and hospitalization for ovarian cyst) and one in the abrupt-cessation group (orchidectomy) occurred while participants were using NRT and concurrently smoking. In participants who used NRT while still smoking, most symptoms of nicotine overdose were

Table 2. Abstinence Outcomes

Abstinence Outcome	Abstinent, *n (%)*		Absolute Difference (95% CI), *percentage points*	Relative Risk (95% CI)*
	Gradual-Cessation Group (*n* = 342)	Abrupt-Cessation Group (*n* = 355)		
Prolonged CO-validated Russell Standard abstinence†				
4 wk after quitting	134 (39.2)	174 (49.0)	9.8 (2.5–17.1)	0.80 (0.66–0.93)
8 wk after quitting	100 (29.2)	130 (36.6)	7.4 (0.4–14.3)	0.80 (0.63–0.95)
6 mo after quitting	53 (15.5)	78 (22.0)	6.5 (0.7–12.2)	0.71 (0.46–0.91)
7-d point prevalence‡, CO-validated†				
4 wk	146 (42.7)	191 (53.8)	9.1 (1.8–16.5)	0.83 (0.72–0.98)
8 wk	106 (31.0)	136 (38.3)	7.3 (0.3–14.3)	0.81 (0.68–1.04)
6 mo	63 (18.4)	94 (26.5)	8.1 (1.9–14.2)	0.70 (0.51–0.97)
Self-reported				
24 h	210 (61.4)	252 (71.0)	9.6 (2.6–16.5)	0.87 (0.77–0.97)

* CO = carbon monoxide. Adjusted for nurses.
† Validated by a CO reading <10 ppm.
‡ No smoking 7 d before assessment.

Figure 2. Prequit exhaled CO concentration and CPD, by trial group.



Data presented are means and 95% CIs. On the *x*-axis, baseline visit refers to the 2 wk before quit day, visit −1 refers to 1 week before quit day, and visit 0 refers to 1 day before quit day. Mean CPD in the gradual-cessation group: baseline, 342; visit -1, 264; visit 0, 184. Mean CO concentration in the gradual-cessation group: baseline, 342 ppm; visit −1, 275 ppm; visit 0, 226 ppm. Mean CPD in the abrupt-cessation group: baseline, 355; visit −1, 299; visit 0, 237. Mean CO concentration in the abrupt-cessation group: baseline, 354 ppm; visit −1, 299 ppm; visit 0, 292 ppm. CO = carbon monoxide; CPD = cigarettes per day.

uncommon and mild and did not differ by group (Appendix Table, available at www.annals.org). Salivating and cold sweats were more common in the gradual-cessation group than abrupt-cessation group in both prequit weeks.

DISCUSSION

We found clear evidence that quitting abruptly was superior in the short and longer term. Adherence to behavioral instructions and prequit NRT was good, and medication was well-tolerated. Participants who preferred to quit gradually were less likely to achieve abstinence, regardless of how they were allocated to quit.

A recent review (8) compared gradual and abrupt cessation approaches and found similar quit rates, with a total RR of 0.94 (CI, 0.79 to 1.13); however, our data show superior results with abrupt cessation. We found evidence that gradual cessation was less successful than abrupt cessation probably because fewer participants made a quit attempt when reducing smoking first. A similar study reported that gradual cessation seemed to deter participants from making quit attempts and reported a substantial, although not statistically significant, advantage of abrupt cessation over gradual cessation (22). Population data show that unaided abrupt attempts to quit are twice as successful as those made by gradually reducing first (4, 7). One explanation could be that gradual cessation requires structure (for example, a quit date or reduction goals) to maximize success (23), and smokers who quit without support may not provide this structure for themselves. Another explanation could be that the motivation to quit predicts the means by which persons quit, and those who are less motivated select gradual cessation (24, 25). Our study supports this notion because participants who favored gradual cessation at baseline were less likely to quit than those who favored abrupt quitting, regardless of allocation.

The use of NRT before quitting makes reduction more successful (13), but it also may enhance the success of cessation regardless of whether reduction occurs. Therefore, we attempted to balance any effect NRT may have had by offering it to both groups. We also guided participants on how to reduce smoking using structured plans, which seems to enhance the success of reduction and subsequent cessation (23). These 2 elements were combined to ensure that we optimized the gradual-cessation group's chance to succeed.

Blinding was impossible; however, there is no reason to believe that false claims of abstinence would have differed between groups and the use of biological verification mitigates this further. Of note, 23% of the English population aged 18 years or older are from an ethnic minority group and most of these groups have a much lower smoking prevalence than the majority population (26). Consequently, nonwhite groups formed only 6% of the trial population and the results may not apply to groups other than white British persons, although we can think of no mechanism that might explain effect modification by ethnic group.

Evidence that gradual cessation is as successful as abrupt cessation would allow smoking cessation programs to adopt this method and allow participants to choose, as suggested in guidelines on tobacco harm reduction from 1 country (27). These results imply that, in clinical practice, we should encourage persons to stop smoking abruptly and not gradually. However, gradual cessation programs could still be worthwhile if

Table 3. Russell Standard 4-wk Quit Rates, Stratified by Baseline Trial Group Preference and Trial Group Allocation*

Baseline Preference for Quitting Method	Participants Abstinent at 4 wk, by Allocation Group		Total Participants Abstinent at 4 wk (*n* = 697)
	Gradual-Cessation Group (*n* = 342)	Abrupt-Cessation Group (*n* = 355)	
Abrupt-cessation group (*n* = 224)	49/107 (45.8)	68/117 (58.1)	117/224 (52.2)
Gradual-cessation group (*n* = 355)	62/179 (34.6)	74/176 (42.0)	136/355 (38.3)
No preference (*n* = 118)	23/56 (41.1)	32/62 (51.6)	55/118 (46.6)

* Values are numbers/totals (percentages).

they increase the number of persons who try to quit or take up support and medication while trying. We need population-focused trials to assess the population effect of promoting and supporting a wider range of quitting options and programs than most countries currently support (28). However, key future developments will be finding means to retain smokers in gradual cessation programs while they reduce smoking, seeking more successful reduction methods, or finding ways of aborting reduction before participants deem it a failure and abandon their quit attempt. For now, however, we conclude that supporting gradual cessation may be a useful way to increase cessation in the population, but abrupt quitting is the more effective method—even in persons who prefer not to.

From the University of Oxford, Oxford; University of Birmingham, Birmingham; and University College London, London, United Kingdom.

Note: Drs. Lindson-Hawley, Aveyard, Michie, and West are members of the United Kingdom Centre for Tobacco and Alcohol Studies (UKCTAS). UKCTAS receive funds from Cancer Research UK; Economic and Social Research Council; Medical Research Council; and National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration.

Grant Support: From the British Heart Foundation.

Disclosures: Dr. Lindson-Hawley reports a grant from the British Heart Foundation to conduct the reported study and grants from the National Institute for Health Research outside the submitted work. Dr. West reports grants, personal fees, and nonfinancial support from Pfizer and and personal fees from GlaxoSmithKline outside the submitted work. Dr. Aveyard reports grants from United Kingdom Centre for Tobacco and Alcohol Studies and the National Institute for Health Research School for Primary Care Research during the conduct of the study; and personal fees from Pfizer and McNeil outside the submitted work. Authors not named here have disclosed no conflicts of interest. Disclosures can also be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M14-2805.

Reproducible Research Statement: *Study protocol*: Published online (open access) at www.trialsjournal.com/content/10/1/69. *Statistical code and data set*: Available to approved persons through written agreements with the author team.

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Appendix: Supplementary Material

Further Detail on Smoking Reduction Methods Used in the Gradual-Cessation Group

In scheduled reduction, participants used a timer (usually a mobile phone) to schedule intercigarette intervals and smoked only when the timer sounded or for 5 minutes thereafter. The time between cigarettes lengthened daily (1, 12). In hierarchical reduction, participants rated cigarettes they would usually smoke from most to least favorite and progressively eliminated either their favorite or least favorite. In smoke-free periods, participants mapped their regular day and noted the 30-minute periods in which they smoked. They then progressively eliminated half and then three quarters of these periods.

Additional Intervention Preference Results

Of the participants who did not achieve abstinence at 4-week follow-up, 56% (219 of 389 participants) would have preferred to quit by gradual cessation (in contrast to quitting abruptly or having no preference) at baseline. At the 4-week visit, those who were not abstinent in both groups and preferred reduction at baseline were more likely to try gradual cessation next time (odds ratio, 5.38 [CI, 2.27 to 12.77]), whereas being allocated to gradual cessation was also associated with an increased propensity to want to quit that way on the next attempt (odds ratio, 4.47 [CI, 1.90 to 10.49]).

Appendix Table. Potential Nicotine Overdose Symptoms Reported by Participants Using Nicotine Replacement Therapy* in the 2 wk Before Quit Day

Nicotine Overdose Symptom	Rates of Symptom Reporting, *n/N (%)*	
	Gradual-Cessation Group (*n* = 98)	**Abrupt-Cessation Group (*n* = 272)**
Week 1 (baseline to visit −1)		
Seizures	0/92 (0)	3/263 (1.1)
Irregular heartbeat	7/93 (7.5)	13/264 (4.9)
Chest pain	6/93 (6.5)	11/263 (4.2)
Cold sweats	11/92 (12.0)	14/262 (5.3)
Abdominal pain	8/92 (8.7)	17/264 (6.4)
Diarrhea	10/94 (10.6)	22/264 (8.3)
Stomach upset	13/94 (13.8)	31/263 (11.8)
Nausea	17/93 (18.3)	53/263 (20.2)
Vomiting	0/92 (0)	5/262 (1.9)
Dizziness	21/93 (22.6)	47/263 (17.9)
Watering mouth	11/91 (12.1)	15/261 (5.7)
Headaches	22/92 (23.9)	71/263 (27.0)
Skin irritation	28/93 (30.1)	106/262 (40.5)
Confusion	9/93 (9.7)	17/246 (6.5)
Weakness	12/92 (13.0)	19/262 (7.3)
Tremor	4/93 (4.3)	7/264 (2.7)
Pallor	2/93 (2.2)	4/264 (1.5)
	Gradual-Cessation Group (*n* = 125)	**Abrupt-Cessation Group (*n* = 264)**
Week 2 (visit −1 to visit 0)		
Seizures	1/119 (0.8)	2/257 (0.8)
Irregular heartbeat	6/122 (4.9)	8/261 (3.1)
Chest pain	4/120 (3.3)	10/261 (3.8)
Cold sweats	15/121 (12.4)	11/261 (4.2)
Abdominal pain	10/120 (8.3)	20/260 (7.7)
Diarrhea	12/120 (10.0)	12/260 (4.6)
Stomach upset	36/261 (13.8)	20/261 (7.7)
Nausea	16/119 (13.4)	36/261 (13.8)
Vomiting	3/121 (2.5)	4/261 (1.5)
Dizziness	18/122 (14.8)	30/260 (11.5)
Watering mouth	18/120 (15.0)	17/259 (6.6)
Headaches	28/120 (23.3)	60/257 (23.3)
Skin irritation	41/121 (33.9)	86/260 (33.1)
Confusion	11/121 (9.1)	11/260 (4.2)
Weakness	10/121 (8.3)	18/259 (6.9)
Tremor	4/120 (3.3)	4/259 (1.5)
Pallor	0/121 (1.0)	4/260 (1.5)

* Daily use of nicotine patch in the abrupt-cessation group and daily use of nicotine patch plus use of an acute form of nicotine replacement therapy on more than half of the days of the week (i.e., ≥4 d) in the gradual-cessation group.