The impact of cigarette branding and plain packaging on perceptions of product appeal and risk among young adults in Norway

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2013-003732
Article Type:	Research
Date Submitted by the Author:	05-Aug-2013
Complete List of Authors:	Scheffels, Janne; Norwegian Institute for Alcohol and Drug Research, Lund, Ingeborg; Norwegian Institute for Alcohol and Drug Research,
Primary Subject Heading:	Public health
Secondary Subject Heading:	Public health
Keywords:	PUBLIC HEALTH, smoking and tobacco, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

The impact of cigarette branding and plain packaging on perceptions of product appeal and risk among young adults in Norway

Authors' names and affiliations

Janne Scheffels & Ingeborg Lund

Norwegian Institute for Alcohol and Drug Research (SIRUS)

Corresponding author

Janne Scheffels

Norwegian Institute for Alcohol and Drug Research (SIRUS)

PO Box 565, Sentrum

0105 Oslo, Norway

js@sirus.no

Tel +47 40631744

Word count: 3260

ABSTRACT

Aim To examine perceptions of cigarette packaging among Norwegian young adults and the potential impact of plain packaging regulations

Methods 1010 15-22 year-olds completed an online survey. First, male and female participants were separately randomized to one out of three experimental conditions: fully branded cigarette packs, the same packs without colors or brand imagery but with descriptor words remaining, and the same packs with descriptors also removed. Participants rated packs on measures of appeal, taste and health risk. Second, participants were asked to compare five pairs of packs from the same brand family on variables aimed at tapping perceptions of health risk and addictiveness.

Results Plain packs were rated significantly less positively on all dimensions among females. Among males, the difference between the branded and plain conditions was significant for taste and appeal. The pack comparison task showed that packs with descriptors suggesting a lower content of harmful substances, together with lighter colors, were more positively rated in the branded compared to the plain conditions.

Conclusion The results indicate that a shift from branded to plain cigarette packaging would lead to a reduction in positive perceptions of cigarettes among young people.

INTRODUCTION

In the process of building a brand, it is crucial to create the right product name and to develop a visual motif or logo that will be imprinted onto consumers' minds as associations with the brand that will differentiate it from competing products in the market. [1] In the marketing of tobacco, such 'cues' related to brand imagery are typically coded into the product's packet design and color scheme. Studies of the previously secret, now released documents from the tobacco industry have shown how cigarette branding has been used to target particular consumer groups and how branding may increase the appeal of smoking. [2-4] These studies have also documented the considerable efforts put into developing cigarette packet designs that would attract consumers [5].

Coloring or brand descriptors related to color (e.g., white, gold) are often used to target a particular gender and to portray smoking in line with the desired brand image. [3] Brand descriptors and images have also been important elements in the tobacco industry's strategy of falsely reassuring consumers about the potential harm of their products. [6] Starting from the indictment of the cigarette for its role in inducing lung cancer in the first Surgeon General's report in 1964, an important function of tobacco marketing has been to reassure consumers about health risks, and, most importantly, to promote ideas that some cigarettes are less dangerous to health than others. Cigarettes labeled 'light' or 'mild' have been marketed as less harmful to health because of substantial reductions in toxin exposure, an assertion that has been thoroughly repudiated by epidemiological data that indicate that smoking these products has little or no health benefit. [7] As smokers tend to compensate for the reduced delivery of nicotine in these products in order to achieve their target nicotine doses, tar delivery has also been shown to increase, effectually cancelling out the presumed benefits of 'low-tar' cigarettes. [8]

Studies have shown that many smokers falsely believe that cigarettes labeled 'light' or 'mild' actually deliver less tar and are less harmful to smokers, and consequently are 'healthier' than regular cigarettes. [9] Norway banned the use of misleading tobacco product descriptors of this kind in 2003, but alternative terms such as 'rounded taste' or references to lighter colors, such as 'pale blue', 'gold' and 'white', are used by a number of brands. Research from countries with similar regulations has shown that smokers continue to believe that some cigarette brands are less harmful than others, and that these beliefs are associated with descriptive words and elements of package designs that have yet to be prohibited, including the names of colors. [10, 11]

Experimental studies have also demonstrated that pack colors and brand imagery such as symbols and graphics can influence consumers' perceptions of the risk involved in using tobacco products. [12, 13] Shades of the same color and the proportion of white space on the package is commonly used to distinguish between variants of the same brand; darker colors are generally used to portray a stronger, full-flavored product, while lighter colors are used to communicate a brand of lower tar and nicotine content. As the color scale moves toward white, associations with cleanliness and a healthy product are targeted.[5, 14]

In recent years, evidence supporting the potential public health benefits of plain packaging has grown. This research has demonstrated, for example, that the removal of brand images from cigarette packaging can reduce the appeal of packs and products, [15-17] significantly reduce false beliefs about health risks and ease of quitting, [13, 18] promote cessation behavior [19] and increase the salience of health warnings. [20] Recent experimental evidence has also shown that removing descriptors from plain packs can decrease ratings of appeal, taste and smoothness further, and also reduce associations with positive attributes. [21, 22]

The current study examined perceptions of cigarette packaging among young adults in Norway. The study aimed to examine the impact of color variations, imagery and brand

descriptors on perceptions of appeal, taste, health risks and ease of quitting, the effect of removing these elements (i.e., plain packaging) on the same variables, and individual differences in perceptions of packaging.

METHODS

One thousand ten male and female smokers and nonsmokers, aged 15–22 years old, were recruited from TNS Gallup's online participant panel during late 2011 and early 2012. Participants were provided with remuneration according to Gallup's standard procedures. This study received full clearance from the Norwegian Social Science Data Services (NSD).

The data collection had an experimental, between-subjects design; participants were assigned to one of three pack conditions: branded, plain with descriptors or plain without descriptors, as illustrated in figure 1. While participants in the branded condition (1) were shown images of standard, fully branded cigarette packages, those assigned to the plain with descriptors condition (2) viewed images of the same packs digitally altered to remove brand imagery and colors, while descriptors (i.e., 'rough taste' or 'white') remained on a plain, grey package. In the plain without descriptors condition (3), participants were shown packages similar to (2), in which descriptors had also been removed.

There were no statistically significant differences in the age, gender or smoker distributions of the participants according to type of pack. Overall, 79.5% were nonsmokers, and 41.8% of the participants were male. The age distribution showed 16.6% were 15–17 year-olds, 44.7% were 18–20 year-olds, and 38.7% were 21–22 year-olds.

All packages included in the study were purposely selected from leading international and Scandinavian brand names to reflect key dimensions of interest in terms of the brand descriptors and brand imagery. For instance, brands that featured different color descriptors (e.g., red vs. gold), and flavor descriptors (e.g., rounded taste vs. rich taste) were selected.

Packages that featured different brand imagery were also selected, including the use of different colors (e.g., red vs. white), and packages in different sizes (10s and 20s). Both English and Norwegian language descriptors were present among the selected brands.

Participants were given two tasks: the first task was an *individual pack rating*, and included 12 individual packs to be rated on perceived appeal, taste and harmfulness. In this section, males and females were shown different pack selections, the males' selection consisting of supposedly 'male-oriented' packs, and the females' selection consisted of supposedly 'female-oriented' packs. The distinction between male and female brands was based upon previous qualitative studies from Norway, [23, 17] as well as presumptions about gender-coded coloring (e.g., lighter pack = feminine) and descriptors (e.g., rough taste = masculine). Four of the brand varieties were the same for both genders. Images of all packs included are shown in tables 1 and 2.

The second task was the *direct pack comparison task*. In this task, participants were shown five pairs of packs from the same brand family with the intent of highlighting the role of descriptors and brand imagery in communicating relative differences between brands. Each pair, made up of packs from the individual pack selections, included a 'regular' brand variety, typically a darker pack containing a product with an average or somewhat high tar and nicotine content, and a 'lighter' variety, typically in a lighter package and with lower nominal levels of tar and nicotine. The paired packs were: Prince Rich Taste vs. Rounded Taste, Marlboro Red vs. Gold Original, Kent Original vs. HD Taste System, Lucky Strike Original vs. Blue and Petteroes Original vs. Lys Blå (Pale Blue). Participants were asked to evaluate the two packages against each other on variables aimed at tapping perceptions of health risk and addictiveness. The pack comparison task was identical for males and females, and there were only two experimental groups: branded and plain with descriptor. This was achieved by

combining the participants in condition 3 (plain without descriptors) and condition 2 (plain with descriptors) into one group for this section of the questionnaire.

Measures

Subjects were asked to indicate how they perceived each individual pack with regard to three characteristics: appeal, taste and harmfulness. Questions were phrased as global comparisons, in the form 'Compared with other brands, how appealing (tasty, harmful) do you think this brand of cigarettes is?' The respondents were given three answer categories, in the form of: less appealing (tasty, harmful), no difference, or more appealing (tasty, harmful). Brandwise, perceived characteristics were recoded into binary variables contrasting those who answered that the brand was more appealing/tasty/harmful (1), with the rest (0). All binary categories were subsequently summed together, creating sum-score indexes for each brand characteristic across all packs, with higher scores signifying more positive characterizations.

In the direct pack comparison task, participants were asked to indicate which, if any, of the two packs in each pair they believed to taste better, to be less harmful, to be of better quality, and to be easier to quit. They were also asked which of the two they would rather try. After recoding the answers into binary variables contrasting those who chose the 'lighter' pack (1) with the rest (0), additive indexes were constructed for each dimension, across all pairs and both genders.

Additional variables used in analyses were age (coded into three age groups), smoking status and perceptions of risk to health from smoking. Smokers were defined as those who had smoked at all during the last 30 days. Respondents were asked whether they believed or knew that smoking could cause 12 different diseases: lung cancer, heart disease, stroke, mouth cancer, cancer of the larynx, emphysema, gangrene, impotence for male smokers, wrinkles and aging of the skin, harm to unborn children, lung cancer for nonsmokers

breathing other people's cigarette smoke, and death. Response options were: Yes, no, and don't know. All positive answers were summed together to create a health risk awareness index. For the logistic regression analyses, the index was recoded into a variable with three values (0–4, 5–8, 9–12).

Analysis

The analyses tested two primary hypotheses: (1) individual fully branded packages will be rated as significantly more appealing, better tasting and less harmful than corresponding plain packs *with* and *without* descriptors. (2) In a direct comparison of 'regular' and 'lighter' packs from the same brand family (e.g., Marlboro vs. Marlboro Gold), the lighter pack will more often be perceived as more appealing, better tasting and less harmful in the branded condition than in the plain (*with* descriptors only) condition. In the analyses of individual packages, logistic regression models were used to test for differences between experimental conditions adjusting for age, smoking status and health risk awareness.

In the instances where the pack selection included more than one variety of a specific brand, the condition 3 version of the second variety pack was altered to white (2 packs in females' selection) or black (3 packs in males' selection) instead of the standard grey. This was done in order to make the task meaningful for the respondents assigned to condition 3, who would otherwise have been asked to differentiate between identical packs. However, as these alternative plain packs made the results difficult to interpret, they are excluded from the presentation of individual scores in tables 1 and 2. In the calculation of mean pack rating index scores presented in table 3, the packs that were black or white in condition 3 were excluded for all conditions. This index is thus calculated from scores on 10 packages for females and 9 for males.

Linear regression analysis was used to test differences in index scores between conditions, adjusting for age, smoking status and health risk awareness. Linear regression analysis was also used to test significant differences between conditions on pack comparison index scores, adjusting for age, gender, smoking status and level of health risk awareness. All analyses were conducted in SPSS version 19.0.

RESULTS

Individual pack ratings

Table 1 shows females' ratings of brand appeal, taste and harmfulness for individual packs. The highest *appeal* ratings in the branded condition were given for Marlboro Gold Original packs (10s and 20s), and Lucky Strike Original 10s. The packs that were given the highest ratings for *taste* by females were the two menthol brands: Salem and Marlboro White Menthol. On the harmfulness dimension, Prince Additive Free was most often rated positively by females, followed by Marlboro White Menthol, Kent HD and Marlboro Gold Original 10s. These are all brands that are sold in pack colors close to white on a scale from darker to lighter packs. The highest occurrence of significant differences between conditions was found for harmfulness

Table 1. Ratings for individual cigarette packages by experimental condition. Females.

Females	 Prince Rounded Taste	 Prince Additive Free	 Salem Menthol	 Petterøes Lys blå	 Lucky Strike Original 10p	 Lucky Strike Blue	 Marlboro Gold Original	 Marlboro White Menthol	 Marlboro Gold Original 10p	 Kent HD	 Camel Filters	 Paramount Red American Blend
MORE APPEALING than other brands (% agree)												
Branded (n=196)	31.6	30.1	18.8	15.8	35.3	26.3	40.2	25.0	41.6	31.8	25.9	8.4
Plain w/d.(n=144)	28.5	27.9	13.5	9.2*	35.8	22.1	25.3*	23.4	32.7*	18.4*	19.3*	11.7
Plain n/d. (n=143)	24.5	-	6.0	10.0	36.0	23.0	31.9*	-	36.4	13.6*	14.5*	8.3
BETTER TASTE than other brands (% agree)												
Branded	23.6	21.7	40.7	11.6	24.9	16.0	28.7	42.3	31.1	25.8	20.1	4.5
Plain w/d.	23.4	23.3	27.2*	9.5	23.3	12.8	23.5*	40.3	28.1	22.6	16.7	5.6
Plain no d.	10.7*	-	4.3*	9.8	26.7	19.1	26.3	-	30.2	13.0*	17.0	10.3
LESS HARMFUL than other brands (% agree)												
Branded	9.9	23.3	13.8	6.3	2.7	10.4	13.9	17.4	16.1	17.4	2.4	3.2
Plain w/d.	2.1*	20.8	10.2	4.2	2.8	3.7*	6.0*	13.8	7.6*	5.7*	4.5	1.6
Plain no d.	1.4*	-	1.7*	1.4*	7.9	3.8*	4.4*	-	10.1	8.3*	3.1	4.2

Values with * indicate significant differences at the p<0.05 level between branded and plain conditions for individual packages in logistic regression models adjusting for age, smoking status and health risk awareness index score.

Table 2 shows males' individual pack ratings. In the branded condition, the pack rated as most *appealing* was the black Marlboro Gold Advance, followed by Lucky Strike Original packs (10s and 20s). The brands most often evaluated as *tasting better* than others were Prince Rich Taste and Camel Natural Flavor, both of which had descriptors focusing on flavor. Two black packs, Kent Taste Surround System and Marlboro Gold Advance, also ranked high for taste. Males most often rated white Marlboro Gold 10 as less harmful than other brands, followed by Camel Natural Flavor. Compared with the situation for females, significant differences between conditions were somewhat less common for males. This difference between the genders was particularly noticeable for perceived harmfulness, where only the Marlboro Gold 10 package showed significant differences between conditions for males.

Table 2. Ratings for individual cigarette packages by experimental condition. Males

Males	Prince Rich Taste 	Prince Golden Taste 	Prince Rounded Taste 	Petterøes Original 	Lucky Strike Original 10 	Lucky Strike Original 20 	Marlboro Filter cigarettes 	Marlboro Gold Advance 	Marlboro Gold 10-pakn 	Kent Surround Taste system 	Camel Natural Flavor 	Paramount Red American Blend 
MORE APPEALING than other brands (% agree)												
Branded	35.6	21.5	28.2	19.3	38.4	38.3	32.1	43.8	28.6	35.3	26.5	12.3
Plain w/d.	31.0*	26.3	24.4	10.4	46.8	39.4	18.6*	27.7*	37.4	20.4*	20.9	17.6
Plain no d.	24.3*	-	-	17.1	40.2	32.7	23.3*	-	25.2	10.4*	20.2	13.3
BETTER TASTE than other brands (% agree)												
Branded	34.0	26.9	28.2	15.4	29.4	30.6	25.9	29.4	29.2	19.6	33.0	8.1
Plain w/d.	34.9*	30.9	36.3	2.6	32.9	30.9	21.9	25.0	26.9	25.0*	29.9	10.0
Plain no d.	15.6*	-	-	15.1	31.9	26.1	16.3	-	20.0*	4.6*	25.0	6.8
LESS HARMFUL than other brands (% agree)												
Branded	2.5	8.6	10.3	1.6	8.5	3.3	4.8	6.1	15.0	9.6	12.4	6.0
Plain w/d.	6.5	3.3	6.7	6.5	7.3	4.3	20.9*	2.3	5.7*	8.6	6.6	5.9
Plain no d.	5.7	-	7.3	1.0	7.5	5.5	1.9	-	4.8*	14.3	4.5	5.1

Values with * indicate significant differences at the p<0.05 level between branded and plain conditions for individual packages in logistic regression models adjusting for age, smoking status and health risk awareness index score.

Table 3 shows the index scores for appeal, taste and harmfulness by gender and experimental condition. Linear regressions were conducted with experimental condition as the main independent variable and each of the characteristics of appeal, taste and harmfulness as the dependent variable, adjusting for age, smoking status and health risk awareness. Plain packages received significantly fewer positive ratings from females on all three dimensions. Among males, the difference between the branded and plain with descriptors conditions was significant for perceptions of taste and appeal.

Table 3. Index scores of perceived brand characteristics by gender and experimental condition.

Experimental condition	Mean score					
	Girls			Boys		
	Appeal	Taste	Less harmful	Appeal	Taste	Less harmful
Branded packs	2,42	1,70	0,82	2,58	1,70	0,52
Plain, with descriptors	1,63**	1,21**	0,34**	2,08*	1,60	0,56
Plain, no descriptors	1,61**	1,12**	0,36**	1,92*	1,18*	0,41

Values with (*) indicate significant difference at the p<0.001 (**) or 0.05(*) level between experimental conditions for each smoker trait in linear regression models adjusting for age, smoking status and health risk awareness index score.

Pack comparisons

Statistical differences between conditions on the index score summing up 'light' pack choices across all pairs were observed for the dimensions 'less harmful', 'would rather try' and 'easier to quit', with larger proportions answering that they believed that the lighter pack variant fitted these descriptions (table 4). Smoking status was a significant confounder in all these models, implying that smokers more often chose the light pack as fitting these descriptions. Risk awareness contributed significantly to explain pack choice for harmfulness, gender had an impact on the willingness to try, and age influenced the perceptions of which pack was easiest to quit.

Table 4. Linear regression predicting viewing the lighter colored pack in a pair of two brand variants more positively regarding of taste, harm, quality, would rather try and easier to quit). Model adjusting for the following covariates: age, smoking status, gender and risk awareness (Beta and p-value of significant covariates listed in table).

Plain (ref: branded)	**Taste better**	**Less harmful**	**Better quality**	**Would rather try**	**Easier to quit**
Beta (β)	-0.12	-0.77	0.04	-0.32	-0.58
95% CI for β	-0.29, 0.06	-0.97, -0.56	-0.11, 0.18	-0.50, -0.14	-0.76,-0.39
P-value	0.191	<0.001	0.627	0.001	<0.001
Moderators (β, significance)	Gender (ref: male) -0.14 (p<0.001)	Smoking status (ref: non-smoker) 0.77 (p<0.001) Risk awareness index 0.05 (p=0.049)	Age (ref: between 15 and 18) -0.11 (p=0.004)	Gender (ref: male) -0.15 (p<0.001) Smoking status (ref: non-smoker) 0.13 (p<0.001)	Age (ref: between 15 and 18) -0.10 (p=0.012) Smoking status (ref: non-smoker) 0.15 (p<0.001)

DISCUSSION

In this study, pack design influenced the way participating youths and young adults perceived cigarette brand characteristics. In the branded condition, individual packs were evaluated in a manner that clearly suggests that color, design elements and descriptors act together in a way that forms consumers' perceptions of product qualities. Females generally perceived white packs as more appealing. Males, on the other hand, typically perceived the darker black packs as more appealing. Results regarding perceptions of taste indicated that descriptors were an important dimension; brands more positively evaluated were those with flavor additives (menthol) or other references to flavor (natural flavor, rich taste). All packs in light colors or with descriptors such as 'additive free' were given higher ratings of harmfulness. Across packs, the branded condition stood out with a higher occurrence of positive brand characteristics than the plain conditions.

The pack comparison task indicated that the use of descriptors suggesting a lower content of harmful substances, together with light colors, affected consumers' perceptions of tobacco products. The 'lighter' pack was selected significantly more often as being less harmful, easier to quit and appealing (a product I would rather try) in the plain condition than in the branded conditions. The strongest of these effects was found for perceptions of a less harmful product. This corresponds with findings from previous qualitative research in Norway, where it was shown that smokers read cigarette packs clearly in accordance with messages related to health risk coded into the color of packs, and the use of descriptors that replaced terms such as 'light' and 'mild', which have been prohibited in Norway since 2003. [17]

Few of the typically 'feminine' cigarette packs sold in other countries, such as packs that look like lipstick boxes, are for sale in Norway, perhaps partly due to the regulations on innovative packaging introduced by the Norwegian Tobacco Act in 1995. Still, Norwegian youth seem to have found their own way of differentiating between masculine and feminine

packs. This illustrates the power of packaging to communicate messages that allow consumers to identify with and differentiate between brands, also when more elaborate elements such as pack shape, opening methods or shape of the cigarette are not being used.

There was a tendency for males to demonstrate somewhat more stable views regardless of condition. This could indicate that pack design is less important for males' perceptions of brand characteristics; perhaps males are less interested in, and therefore less influenced by, the design of cigarette packs? On the other hand, the shortage of significant differences between conditions among males could be the result of a very high degree of awareness of the differences between brand images. An intrinsic weakness in the study design is in fact that all participants would have been quite familiar with the design of the branded cigarette packs, and may have formed ideas about the products and their qualities before they took part in the study. This possibility is augmented by the fact that the packs included in the samples tended to be quite popular and well-known. However, if respondents in the plain conditions let former ideas about brand characteristics influence their answers, it is likely that this would have worked to diminish the difference between the results in the different conditions more than if the participants were neutral from the start. The between-subject design also carries with it some challenges, predominantly the risk of uncontrolled variation between groups, or in this case, between conditions. Fortunately, the groups did not differ statistically from each other in terms of age, smoking status or gender, but it is of course possible that other, unmeasured factors could have influenced the variation found between groups.

In conclusion, the results of this study indicate that a shift from branded to plain cigarette packaging would lead to a reduction in positive perceptions of cigarettes among adolescents. From the viewpoint that positive images attached to smoking and specific brands allow users to create identities through their smoking that they project to others, [18, 23] identical packaging for all brands would remove the opportunity to signal affinity to any particular

subgroup of smokers, making a cigarette merely a deliverer of nicotine, regardless of brand. To the extent that plain packaging contributes to making smoking images less positive, it can potentially be an efficient aid in reducing smoking uptake among adolescents. The finding that respondents so clearly make distinctions regarding harmfulness and ease of quitting between brand varieties based upon colors and descriptors also points toward the conclusion that cigarette descriptors such as 'rounded taste' (in contrast to 'rough taste') and color codes such as 'gold' or 'pale blue' are perceived in a similar way as the prohibited terms 'light' and 'mild'. The use of these terms thus appears to violate the guidelines of the WHO Framework Convention on Tobacco Control treaty, which forbids information that directly or indirectly creates the false impression that a particular tobacco product is less harmful than other tobacco products. The results are comparable with packaging studies in other countries, which highlight the common marketing practices used across global markets. Overall, they describe how packages communicate messages that allow consumers to identify with and differentiate between cigarette brands and thus are essential in the processes by which branding works to promote tobacco products.

Article summary

Article focus

- Cigarette packaging is an important component of tobacco marketing, and in recent years evidence supporting the potential public health benefits of plain packaging has grown
- This paper examines perceptions of branded and plain packaging among young adults in Norway

Key messages

- Findings indicate that branded cigarette packages communicate messages that allows consumers to identify with and differentiate between brands
- Plain packages were rated less positively than branded packages on a range of dimensions
- The results indicate that plain packaging is likely to diminish the power of branding as promotion of tobacco products

Strengths and limitations

- This study report findings that can illustrate the significance of branding in several ways, and includes both male and female respondents
- A limitation of the study is that respondents in the plain conditions may associate cigarette brand names with former ideas about the brands

Competing interests

None.

Funding

This study was funded in its entirety by the Norwegian Institute for Alcohol and Drug Studies (SIRUS).

Contributionship statement

Janne Scheffels designed the study, performed the main part of the analysis and drafted the paper. Ingeborg Lund performed some of the analysis and took part in drafting the paper.

Data sharing statement

No unpublished data from this study are available after the publication of his study.

References

1. Carter SM. The Australian cigarette brand as product, person and symbol. *Tob Control* 2003;**12**:iii79–iii86.
2. Wayne GF, Connolly G. How cigarette design can affect youth initiation into smoking: Camel cigarettes 1983–93. *Tob Control* 2002;**11**:i32–i39.
3. Anderson SJ, Glantz SA, Ling PM. Emotions for sale: cigarette advertising and women's psychosocial needs. *Tob Control* 2005;**14**:127–35.
4. Carpenter CM, Wayne GF, Connolly GN. Designing cigarettes for women: new findings from the tobacco industry documents. *Addiction* 2005;**100**:837–51.
5. Wakefield M, Morley C, Horan JK, et al. The cigarette pack as image: new evidence from tobacco industry documents. *Tob Control* 2002;**11**(suppl 1):i73–i80.
6. Pollay RW, Dewhirst T. The dark side of marketing seemingly 'light' cigarettes: successful images and failed fact. *Tob Control* 2002;**11**(1):18–31.
7. Thun MJ, Burns DM. Health impact of 'reduced yield' cigarettes: a critical assessment of the epidemiological evidence. *Tob Control* 2001;**10**(1):4–11.
8. Hecht SS, Murphy SE, Carmella SG, et al. Similar uptake of lung carcinogens by smokers of regular, light, and ultralight cigarettes. *Cancer Epidemiol Biomarkers Prev*, 2005;**14**:639–98.
9. Wilson N, Weerasekera D, Peace J, et al. Misperceptions of 'light' cigarettes abound: national survey data. *BMC Public Health* 2009;**9**:126.
10. Borland R, Fong GT, Yong HH, et al. What happened to smokers' beliefs about light cigarettes when 'light/mild' brand descriptors were banned in the UK? Findings from the International Tobacco Control (ITC) Four Country Survey. *Tob Control* 2008;**17**:256–62.

11. Mutti S, Hammond D, Borland R, et al. Beyond light and mild: Cigarette brand descriptors and perceptions of risk in the International Tobacco Control (ITC) four country survey. *Addiction* 2011;**106**;1166–75.
12. Hammond D, Dockrell M, Arnott D, et al. Cigarette package design and perceptions of risk among UK adults and youth. *Eur J of Public Health* 2009;**19**(6):631–37.
13. Wakefield MA, Germain D, Durkin SJ. How does increasingly plainer cigarette packaging influence adult smokers' perceptions about brand image? An experimental study. *Tob Control,* 2008;**17**:416–21.
14. Ford A, Moodie C, Hastings G. The role of packaging for consumers products: understanding the move towards 'plain' tobacco packaging. *Addict Res Theory* 2012;**20(4):**339-347.
15. Wakefield MA, Germain D, Durkin SJ. How does increasingly plainer cigarette packaging influence adult smokers' perceptions about brand image? An experimental study. *Tob Control,* 2008;**17**:416–21.
16. Moodie C, Ford A, Mackintosh AM, et al. Young people's perceptions of cigarette packaging and plain packaging: an online survey. *Nic Tob Res* 2012;**14**(1):98–105.
17. Scheffels J, Sæbø G. Perceptions of plain and branded cigarette packaging among Norwegian youth and adults: a focus group study. *Nic Tob Res* 2013, **15 (2)**: 450-456.
18. Hoek J, Gendall P, Gifford H, et al. Tobacco branding, plain packaging, pictorial warnings, and symbolic consumption. *Qualitative Health Research* 2012;**22**(5), 630–9.
19. Hoek J, Wong C, Gendall P, et al. Effects of dissuasive packaging on young adult smokers. *Tob Control* 2011;**20**:183–188.

20. Munafo MR, Roberts N, Bauld L, et al. Plain packaging increases visual attention to health warnings on cigarette packs in non-smokers and weekly smokers but not daily smokers. *Addiction* 2011:**106**(8):1505–10.

21. White CM, Hammond D, Thrasher JF, et al. The potential impact of plain packaging of cigarette products among Brazilian young women: an experimental study. *BMC Public Health* 2012;12.

22. Hammond D, Daniel S, White CM. The effect of cigarette branding and plain packaging on female youth in the United Kingdom. *J Adolesc Health,* 2012; **2(2)**:151-157.

23. Scheffels J. A difference that makes a difference: young adult smokers' accounts of cigarette brands and package design. *Tob Control* 2008;**17**(2):118–122.

Figure legend

Figure 1 Examples of the three versions of cigarette packs.

Branded Plain with descriptors Plain without descriptor

Figure 1. Examples of the three versions of cigarette packs.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	5,8
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	*5*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5,14
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9,11,13,14
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17,18
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

The impact of cigarette branding and plain packaging on perceptions of product appeal and risk among young adults in Norway. A between-subjects experimental survey

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2013-003732.R1
Article Type:	Research
Date Submitted by the Author:	25-Oct-2013
Complete List of Authors:	Scheffels, Janne; Norwegian Institute for Alcohol and Drug Research, Lund, Ingeborg; Norwegian Institute for Alcohol and Drug Research,
Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Public health, Communication
Keywords:	PUBLIC HEALTH, PREVENTIVE MEDICINE, SOCIAL MEDICINE

The impact of cigarette branding and plain packaging on perceptions of product appeal and risk among young adults in Norway. A between-subjects experimental survey

Authors' names and affiliations

Janne Scheffels & Ingeborg Lund

Norwegian Institute for Alcohol and Drug Research (SIRUS)

Corresponding author

Janne Scheffels

Norwegian Institute for Alcohol and Drug Research (SIRUS)

PO Box 565, Sentrum

0105 Oslo, Norway

js@sirus.no

Tel +47 40631744

Word count: 3810

ABSTRACT

Objectives This study **e**xamined perceptions of cigarette packaging and the potential impact of plain packaging regulations. The hypothesis was that branded cigarette packages would be rated more positively than corresponding plain packs *with* and *without* descriptors.

Design Between-subjects experimental online survey. Male and female participants were separately randomized to one out of three experimental conditions: fully branded cigarette packs, plain packs with descriptors, and plain packs without descriptors asked to evaluate 12 individual cigarette packages. Participants were also asked to compare 5 pairs of packs from the same brand family.

Setting Norway

Participants 1010 youths and adults aged15-22.

Primary outcome measures Ratings of appeal, taste and harmfulness for individual packages. Ratings of taste, harm, quality, 'would rather try' and 'easier to quit' for pairs of packages

Results Plain with and without descriptors packs were rated less positively than branded on appeal (index score 1.63/1.61 vs 2.42, p<0.001), taste (index score 1.21/1.12 vs 1.70, p<0.001) and less harmful (index score 1.0.34/0.36 vs 0.82, p<0.001). Among males, the difference between the plain with and without descriptors versus branded condition was significant for appeal (index score 2.08/1.92 vs 2.58, p<0.005) and between the plain without descriptors versus branded condition was for taste (index score 1.18 vs 1,70, p<0.00). The pack comparison task showed that packs with descriptors suggesting a lower content of harmful substances, together with lighter colors, were more positively rated in the branded

Article summary

Article focus

- Cigarette packaging is an important component of tobacco marketing, and in recent years evidence supporting the potential public health benefits of plain packaging has grown
- This paper examines perceptions of branded and plain packaging among young adults in Norway

Key messages

- Findings indicate that branded cigarette packages communicate messages that allows consumers to identify with and differentiate between brands
- Plain packages were rated less positively than branded packages on a range of dimensions
- The results indicate that plain packaging can contribute to diminish the power of branding as promotion of tobacco products and counter misperceptions that some products are less harmful than others

Strengths and limitations

- The between-subjects design provides a qualitative overview of evaluations of a different branded cigarette packs, in addition to results on differences in perceptions of branded and plain packs.
- Respondents in the three conditions did not differ statistically from each other in terms of age, smoking status or gender, but other, unmeasured factors could have influenced the variation found between groups

compared to the plain condition on dimensions less harmful (β-0.77, 95% CI -0.97,-0.56), would rather try (β-0.32, 95% CI -0.50,-0.14) and easier to quit (β-0.58, 95% CI -0.76,-0.39).

Conclusion The results indicate that a shift from branded to plain cigarette packaging could lead to a reduction in positive perceptions of cigarettes among young people.

INTRODUCTION

In the process of building a brand, it is crucial to create the right product name and to develop a visual motif or logo that will be imprinted onto consumers' minds as associations with the brand that will differentiate it from competing products in the market. [1] In the marketing of tobacco, such 'cues' related to brand imagery are typically coded into the product's packet design and color scheme. Studies of documents from the tobacco industry have shown how cigarette branding has been used to target particular consumer groups, how branding may increase the appeal of smoking [2-4], and how considerable efforts have been put into developing cigarette packet designs that attract consumers [5].

Particularly in dark markets, cigarette pack design has become a main vehicle for tobacco marketing. Coloring and color descriptors are key measures used for communicating messages about the product, e.g to target a particular gender or to portray smoking in line with the desired brand image. [3] Shades of the same color and the proportion of white space on the package are commonly used to distinguish between variants of the same brand, with darker colors generally used to portray a stronger, full-flavored product, and lighter colors to communicate a brand of lower tar and nicotine content. As the color scale moves toward white, associations with cleanliness and a healthy product are targeted. [5] Brand descriptors and images have also been important elements in the tobacco industry's strategy of falsely reassuring consumers about the potential harm of their products. [6] Cigarettes labeled 'light' or 'mild' have been marketed as less harmful to health due to reductions in toxin exposure, an assertion that has been thoroughly repudiated by epidemiological data indicating that smoking these products has little or no health benefit [7] and, as smokers tend to compensate for reduced delivery of nicotine, tar delivery increases, effectually cancelling out the presumed benefits of 'low-tar' cigarettes. [8] Research has shown that many smokers falsely believe that

cigarettes labeled 'light' or 'mild' actually deliver less tar and are less harmful to smokers [9]. Furthermore, regulating the use of such descriptors does not seem to be sufficient to correct these beliefs. Studies from jurisdictions where regulations on misleading descriptors have been implemented have exposed that many smokers continue to believe that some cigarette brands are less harmful than others, and that these beliefs are associated with descriptive words and elements of package designs that have yet to be prohibited, including the names of colors. [10, 11]

In order to limit the package design opportunity of communication between tobacco producers and consumers (and potential consumers in particular), several jurisdictions have considered regulations on package design, [12] and Australia was the first country to implement plain packaging of tobacco products, in December 2012. While it is still early to draw conclusions about the real life effect of plain packaging, a growing body of experimental evidence supports the potential public health benefits of plain packaging. Studies have e.g demonstrated that pack colors and brand imagery such as symbols and graphics can influence consumers' perceptions of the risk involved in using tobacco products, [13, 14] and that the removal of brand images from cigarette packaging can reduce the appeal of packs and products. [15-17] Experimental research has also indicated that plain packaging can significantly reduce false beliefs about health risks and ease of quitting, [13, 18] promote cessation behavior [19] and increase the salience of health warnings. [20] Recent research has also indicated that removing descriptors from plain packs can decrease ratings of appeal, taste and smoothness further, and also reduce associations with positive attributes. [21, 22]

In Norway, qualitative studies have indicated that the power of tobacco branding remains strong [23], despite strict regulations on marketing. A relatively limited array of tobacco brands and pack designs are for sale, probably due to the size of the market as well as the regulatory environment. Since 1975, when all tobacco advertising was banned, a range of

additional tobacco marketing restrictions have been implemented, including restrictions on selling cigarette packages that because of 'unconventional design or an appearance can lead to increased sales' (1995), misleading brand descriptors (2003), and a complete point of sale display ban (2010). Combined with consistently high tobacco tax levels and other important judicial restrictions such as the ban on indoor smoking in public areas in 2004, these regulations on tobacco marketing have probably contributed to the reductions in daily smoking prevalence in recent years, as well as influenced the characteristics of the tobacco market.

The aim of the current study was to examine perceptions of cigarette packaging among young adults in a context where marketing is highly restricted and where pack designs are less innovative than in many other jurisdictions. More specifically, the aim was to examine the impact of color variations, imagery and brand descriptors on perceptions of appeal, taste, health risks and ease of quitting, the effect of removing these elements (i.e., plain packaging) on the same variables, and individual differences in perceptions of packaging.

METHODS

One thousand ten male and female smokers and nonsmokers, aged 15–22 years old, were recruited from TNS Gallup's online participant panel during 2011. The panel is representative of the population as regards demographical variables, panelists were invited into the survey with age and gender as inclusion criteria. All participants were provided with remuneration according to Gallup's standard procedures. This study received full clearance from the Norwegian Data Protection Official for Research, including ethical evaluation (project number 34433). The data collection had an experimental, between-subjects design; participants were randomly assigned to one of three pack conditions: branded, plain with descriptors or plain without descriptors, as illustrated in figure 1. While participants in the

branded condition (1) were shown images of standard, fully branded cigarette packages, those assigned to the plain with descriptors condition (2) viewed images of the same packs digitally altered to remove brand imagery and colors, while descriptors (i.e., 'rough taste' or 'white') remained on a plain, grey package. In the plain without descriptors condition (3), participants were shown packages similar to (2), in which descriptors had also been removed.

The studies mandating a grey/olive plain pack color made before the implementation of the Australian plain packaging legislation had not been done at the time we designed this study. The grey plain pack color was chosen based upon a common sense evaluation of grey as a color signifying 'indistinctive' and unappealing. The cupboards used to cover tobacco products in shops after the point-of-sale display ban was implemented in Norway usually has a similar grey color, [24] underlining perhaps the cultural connotations of this color in the local context that this study was undertaken in.

All packages included in the study were purposely selected from leading international and Scandinavian brand names to reflect key dimensions of interest in terms of the brand descriptors and brand imagery. For instance, brands that featured different color descriptors (e.g., red vs. gold), and flavor descriptors (e.g., rounded taste vs. rich taste) were selected. Packages that featured different brand imagery were also selected, including the use of different colors (e.g., red vs. white), and packages in different sizes (10s and 20s).

Both English and Norwegian language descriptors were present among the selected brands. English is a language spoken among a large majority of the population in Norway and in particular among young people. It is thus unlikely that the respondents had problems understanding the descriptor words in any of the languages. There were no statistically significant differences in the age, gender or smoker distributions of the participants according to pack condition. Overall, 79.5% were nonsmokers, and 41.8% of the participants were male.

The age distribution showed 16.6% were 15–17 year-olds, 44.7% were 18–20 year-olds, and 38.7% were 21–22 year-olds.

Participants were given two tasks; the first task was an *individual pack rating*, and included 12 individual packs to be rated on perceived appeal, taste and harmfulness. In this section, males and females were shown different pack selections, the males' selection consisting of supposedly 'male-oriented' packs, and the females' selection consisted of supposedly 'female-oriented' packs. The distinction between male and female brands was based upon previous qualitative studies from Norway, [23, 17] as well as presumptions about gender-coded coloring (e.g., lighter pack = feminine) and descriptors (e.g., rough taste = masculine). Four of the brand varieties were the same for both genders. Images of all packs included are shown in tables 1 and 2. An automatic function securing that the packs were presented to individual respondents in a random order was programmed into the setup of the survey. The second task was the *direct pack comparison task*. In this task, participants were shown five pairs of packs from the same brand family with the intent of highlighting the role of descriptors and brand imagery in communicating relative differences between brands. Each pair, made up of packs from the individual pack selections, included a 'regular' brand variety, typically a darker pack containing a product with an average or somewhat high tar and nicotine content, and a 'lighter' variety, typically in a lighter package and with lower nominal levels of tar and nicotine. The paired packs were: Prince Rich Taste vs. Rounded Taste, Marlboro Red vs. Gold Original, Kent Original vs. HD Taste System, Lucky Strike Original vs. Blue and Petteroes Original vs. Lys Blå (Pale Blue). Participants were asked to evaluate the two packages against each other on variables aimed at tapping perceptions of health risk and addictiveness. The pack comparison task was identical for males and females, and there were only two experimental groups: branded and plain with descriptor. This was achieved by

combining the participants in condition 3 (plain without descriptors) and condition 2 (plain with descriptors) into one group for this section of the questionnaire.

Measures

Subjects were asked to indicate how they perceived each individual pack with regard to three characteristics: appeal, taste and harmfulness. Questions were phrased as global comparisons, in the form 'Compared with other brands, how appealing (tasty, harmful) do you think this brand of cigarettes is?' The respondents were presented with four answer categories, in the form of: less appealing (tasty, harmful), no difference, or more appealing (tasty, harmful) and don't know'. Brandwise, perceived characteristics were recoded into binary variables contrasting those who answered that the brand was more appealing/tasty/harmful (1), with the rest (0). All binary categories were subsequently summed together, creating sum-score indexes for each brand characteristic across all packs, with higher scores signifying more positive characterizations.

In the direct pack comparison task, participants were asked to indicate which, if any, of the two packs in each pair they believed to taste better, to be less harmful, to be of better quality, and to be easier to quit. They were also asked which of the two they would rather try. After recoding the answers into binary variables contrasting those who chose the 'lighter' pack (1) with the rest (0), additive indexes were constructed for each dimension, across all pairs and both genders.

Additional variables used in analyses were age (coded into three age groups), smoking status and perceptions of risk to health from smoking. Smokers were defined as those who had smoked at all during the last 30 days. Respondents were asked whether they believed or knew that smoking could cause 12 different diseases: lung cancer, heart disease, stroke, mouth cancer, cancer of the larynx, emphysema, gangrene, impotence for male smokers,

wrinkles and aging of the skin, harm to unborn children, lung cancer for nonsmokers breathing other people's cigarette smoke, and death. Response options were: Yes, no, and don't know. All positive answers were summed together to create a health risk awareness index. For the logistic regression analyses, the index was recoded into a variable with three values (0–4, 5–8, 9–12).

Analysis

The analyses tested two primary hypotheses: (1) individual fully branded packages will be rated as significantly more appealing, better tasting and less harmful than corresponding plain packs *with* and *without* descriptors. (2) In a direct comparison of 'regular' and 'lighter' packs from the same brand family (e.g., Marlboro vs. Marlboro Gold), the lighter pack will more often be perceived as more appealing, better tasting and less harmful in the branded condition than in the plain (*with* descriptors only) condition. In the analyses of individual packages, logistic regression models were used to test for differences between experimental conditions adjusting for age, smoking status and health risk awareness.

In the instances where the pack selection included more than one variety of a specific brand, the condition 3 version of the second variety pack was altered to white (2 packs in females' selection) or black (3 packs in males' selection) instead of the standard grey. This was done in order to make the task meaningful for the respondents assigned to condition 3, who would otherwise have been asked to differentiate between identical packs. However, as these alternative plain packs made the results difficult to interpret, they are excluded from the presentation of individual scores in tables 1 and 2. In the calculation of mean pack rating index scores presented in table 3, the packs that were black or white in condition 3 were excluded for all conditions. This index is thus calculated from scores on 10 packages for females and 9 for males.

Linear regression analysis was used to test differences in index scores between conditions, adjusting for age, smoking status and health risk awareness. Linear regression analysis was also used to test significant differences between conditions on pack comparison index scores, adjusting for age, gender, smoking status and level of health risk awareness. All analyses were conducted in SPSS version 19.0.

RESULTS

Individual pack ratings

Table 1 shows females' ratings of brand appeal, taste and harmfulness for individual packs. The highest *appeal* ratings in the branded condition were given for Marlboro Gold Original packs (10s and 20s), and Lucky Strike Original 10s. The packs that were given the highest ratings for *taste* by females were the two menthol brands: Salem and Marlboro White Menthol. On the harmfulness dimension, Prince Additive Free was most often rated positively by females, followed by Kent HD, Marlboro White Menthol and Marlboro Gold Original 10s. These are all brands that are sold in packets with colors close to white on a scale from darker to lighter packs. The highest occurrence of significant differences between conditions was found for harmfulness

Table 1. Female ratings for individual cigarette packages by experimental condition (n condition 1=221, n condition 2=195, n condition 3=172)

Females	 Prince Rounded Taste	 Prince Additive Free	 Salem Menthol	 Petterøes Lys blå	 Lucky Strike Original 10p	 Lucky Strike Blue	 Marlboro Gold Original	 Marlboro White Menthol	 Marlboro Gold Original 10p	 Kent HD	 Camel Filters	 Paramount Red American Blend
MORE APPEALING than other brands (% agree)												
1 Branded	28.6	26.5	16.5	14.3	32.6	22.8	36.5	21.9	36.2	28.1	22.8	7.4
2 Plain w/d.	21.2	20.2	9.9	7.3*	27.5	16.4	20.1*	17.3	25.9*	14.0*	14.6*	7.8
3 Plain no d.	20.6	-	4.1	8.1	28.7	18..1	25.9*	-	31.8	9.9*	11.7*	11.7
BETTER TASTE than other brands (% agree)												
1 Branded	18.8	15.1	31.1	8.8	19.3	11.6	22.6	33.8	23.0	19.0	14.8	3.3
2 Plain w/d.	15.6	14.6	17.7*	6.2	14.5	7.9	14.4*	27.4	17.6	14.6	10.4	3.1
3 Plain no d	7.8*	-	2.3*	7.0	18.8	12.9	18.2	-	15.9	8.8*	11.0	5.8
LESS HARMFUL than other brands (% agree)												
1 Branded	8.3	19.2	11.9	6.3	8.7	8.7	12.4	14.6	14.2	14.9	1.9	2.8
2 Plain w/d.	1.6*	15.5	6.8	4.2	2.1	2.6*	4.7*	10.0	5.7*	4.2*	3.1	1.0
3 Plain no d	1.2*	-	1.2*	1.2*	6.4	2.9*	4.4*	-	8.1	6.4*	2.3	2.3

Values with * indicate significant differences at the p<0.05 level between branded and plain conditions for individual packages in logistic regression models adjusting for age, smoking status and health risk awareness index score.

Table 2 shows males' individual pack ratings. In the branded condition, the pack rated as most *appealing* was the black Marlboro Gold Advance, followed by Lucky Strike Original (10s and 20s). The brands most often evaluated as *tasting better* than others were Prince Rich Taste and Camel Natural Flavor, both of which had descriptors focusing on flavor. Males most often rated white Marlboro Gold 10 as less harmful than other brands, followed by Camel Natural Flavor. Compared with the situation for females, significant differences between conditions were somewhat less common for males. This difference between the genders was particularly noticeable for perceived harmfulness, where the analysis showed significant differences between conditions only for two packages, compared to seven among females.

Table 2. Male ratings for individual cigarette packages by experimental condition (n condition 1=163, n condition 2=118, n condition 3=143)

Males	Prince Rich Taste 	Prince Golden Taste 	Prince Rounded Taste 	Petterøes Original 	Lucky Strike Original 10 	Lucky Strike Original 20 	Marlboro Filter cigarettes 	Marlboro Gold Advance 	Marlboro Gold 10-pakn 	Kent Surround Taste system 	Camel Natural Flavor 	Paramount Red American Blend 
MORE APPEALING than other brands (% agree)												
1 Branded	30.8	17.4	23.1	17.1	33.5	32.3	27.5	36.1	28.6	29.8	22.2	10.1
2 Plain w/d.	22.6*	21.6	19.1	8.5	38.5	31.4	13.8*	22.4*	37.4	16.8*	16.4	13.0
3 Plain no d.	17.5*	-	-	12.5	31.5	26.1	16.8*	-	25.2	7.7*	16.2	9.2
BETTER TASTE than other brands (% agree)												
1 Branded	22.5	18.0	18.4	11.4	20.3	20.9	17.6	19.0	21.0	12.6	22.9	5.7
2 Plain w/d.	25.0	21.6	25.2	1.7*	23.3	21.2	13.8	16.4	17.9	17.7	19.7	6.1
3 Plain no d.	9.9*	-	-	9.2	20.3	17.0	10.5	-	12.7*	2.8*	15.4	3.6
LESS HARMFUL than other brands (% agree)												
1 Branded	1.9	6.2	7.3	1.3	6.3	2.5	3.8	4.4	12.0	7.0	9.6	4.5
2 Plain w/d.	5.2	2.6	5.3	5.2	6.0	3.4	15.7*	1.7	4.3*	6.2	5.1	4.3
3 Plain no d.	4.2	-	5.6	0.7	5.6	4.2	1.4	-	3.5*	10.5	3.5	3.5

Values with * indicate significant differences at the p<0.05 level between branded and plain conditions for individual packages in logistic regression models adjusting for age, smoking status and health risk awareness index score.

Table 3 shows the index scores for appeal, taste and harmfulness by gender and experimental condition. Linear regressions were conducted with experimental condition as the main independent variable and each of the characteristics of appeal, taste and harmfulness as the dependent variable, adjusting for age, smoking status and health risk awareness. Plain packages received significantly fewer positive ratings from females on all three dimensions. Among males, the difference between the branded and both plain conditions was significant for perceptions of appeal, and between branded and plain, no descriptors for taste.

Table 3. Index scores of perceived positive brand characteristics by gender and experimental condition.

Experimental condition	Mean score					
	Girls			Boys		
	Appeal	Taste	Less harmful	Appeal	Taste	Less harmful
Branded packs	2,42	1,70	0,82	2,58	1,70	0,52
Plain, with descriptors	1,63**	1,21**	0,34**	2,08*	1,60	0,56
Plain, no descriptors	1,61**	1,12**	0,36**	1,92*	1,18*	0,41

Values with (*) indicate significant difference at the p<0.001 (**) or 0.05(*) level between experimental conditions for each smoker trait in linear regression models adjusting for age, smoking status and health risk awareness index score.

Pack comparisons

Statistical differences between conditions on the index score summing up 'light' pack choices across all pairs were observed for the dimensions 'less harmful', 'would rather try' and 'easier to quit', with larger proportions answering that they believed that the lighter pack variant fitted these descriptions (table 4). Smoking status was a significant confounder in all these models, implying that smokers more often chose the light pack as fitting these descriptions. Risk awareness contributed significantly to explain pack choice for harmfulness, gender had an impact on the willingness to try, and age influenced the perceptions of which pack was easiest to quit.

Table 4. Linear regression predicting viewing the lighter colored pack in a pair of two brand variants more positively regarding of taste, harm, quality, would rather try and easier to quit). Model adjusting for the following covariates: age, smoking status, gender and risk awareness (Beta and p-value of significant covariates listed in table).

Plain (ref: branded)	**Taste better**	**Less harmful**	**Better quality**	**Would rather try**	**Easier to quit**
Beta (β)	-0.12	-0.77	0.04	-0.32	-0.58
95% CI for β	-0.29, 0.06	-0.97, -0.56	-0.11, 0.18	-0.50, -0.14	-0.76,-0.39
P-value	0.191	<0.001	0.627	<0.001	<0.001
Moderators (β, significance)	Gender (ref: male) -0.14 (p<0.001)	Smoking status (ref: non-smoker) 0.77 (p<0.001) Risk awareness index 0.05 (p=0.049)	Age (ref: between 15 and 18) -0.11 (p=0.004)	Gender (ref: male) -0.15 (p<0.001) Smoking status (ref: non-smoker) 0.13 (p<0.001)	Age (ref: between 15 and 18) -0.10 (p=0.012) Smoking status (ref: non-smoker) 0.15 (p<0.001)

DISCUSSION

In this study, pack design influenced the way participating youths and young adults perceived cigarette brand characteristics. Among girls, the analysis across all individual packages showed that branded packages significantly more often were rated as appealing, as tasting better and as less harmful than plain packages both with and without descriptors. Boys rated branded packages more positively compared to plain packages both with and without descriptors for appeal, and more positively compared to plain packages without descriptors for taste. The pack comparison task indicated that the use of descriptors suggesting a lower content of harmful substances, together with light colors, affected consumers' perceptions of tobacco products. The 'lighter' packs were significantly more often selected as being less harmful, easier to quit and appealing (a product I would rather try) in the branded condition than in the plain condition. The strongest of these effects was found for perceptions of a less harmful product.

The pattern of how individual packages were evaluated in the branded condition clearly suggested that color, design elements and descriptors act together in a way that forms consumers' perceptions of product qualities. Females generally perceived white packs as more appealing while males typically preferred the darker packs, indicating that the tobacco producers' strategies for building associations and identification [4, 5] are successful also in a country where the marketing of tobacco products is very restricted. Results regarding perceptions of taste indicated that descriptors were an important dimension; brands more positively evaluated were those with flavor additives (menthol) or other references to flavor (natural flavor, rich taste). All packs in light colors or with descriptors such as 'additive free' were more positively rated regarding harmfulness.

Interestingly, even though the general pattern as expected was that removing descriptors from plain packages decreased positive perceptions of packs, the plain *without*

descriptor packs were in some of the analyses of individual packages rated more positively than the plain packs *with* descriptors. This pattern appeared to be most noticeable for strong brand names such as Marlboro or Lucky Strike. Other studies of plain packaging and descriptors have reported similar patterns [21, 22] and inferred that brand family names may become relatively more important in distinguishing between brands and promoting appeal in the absence of brand imagery and descriptors.

Few of the typically 'feminine' cigarette packs sold in other countries, such as packs that look like lipstick boxes or packs with typically feminine names such as e.g *Vogue* or *Slims*, are for sale in Norway, perhaps partly due to the regulations on 'unconventional' packaging. Still, Norwegian youth seem to have found their own way of differentiating between masculine and feminine packs. We observed that packs that are likely to appear more gender neutral in countries where such packs *are* at sale, e.g Marlboro Original Gold [21] seem to be popular among girls in Norway, probably partly because of a position as feminine [23]. This illustrates the power of packaging to communicate messages that allow consumers to identify with and differentiate between brands, also when more conspicuous designs and elaborate elements such as pack shape, opening methods or shape of the cigarette are not being used.

There was a tendency for males to demonstrate somewhat more stable views regardless of condition. This could indicate that pack design is less important for males' perceptions of brand characteristics; perhaps males are less interested in, and therefore less influenced by, the design of cigarette packs? It has been documented that the tobacco industry has made particular efforts to design cigarette packages more attractive for girls. [4] On the other hand, the shortage of significant differences between conditions among males could be the result of a very high degree of awareness of the differences between brand images, so that the brand associations stay on after only the brand name remains to identify the product. Previous

research has concluded both in favor [25] and against [26] the significance of gender on perceptions of pack design and plain packaging.

An intrinsic weakness in the study design is that all participants would have been quite familiar with the design of the branded cigarette packs, and may have formed ideas about the products and their qualities before they took part in the study. This possibility is augmented by the fact that the packs included in the samples tended to be quite popular and well-known. However, if respondents in the plain conditions let former ideas about brand characteristics influence their answers, it is likely that this would have worked to diminish the difference between the results in the different conditions more than if the participants were neutral from the start. Another possible limitation of this study is that the color used to represent plain packaging may have influenced respondents' perceptions in a different way than intended. Studies from other countries evaluating the suitability of different colors have e.g concluded that grey is perceived less negatively than brown. [25] This concern is to some extent reduced by findings from qualitative studies indicating that grey plain cigarette packages are perceived negatively in Norway. [17] The between-subject design also carries with it some challenges, predominantly the risk of uncontrolled variation between groups, or in this case, between conditions. Fortunately, the groups did not differ statistically from each other in terms of age, smoking status or gender, but it is of course possible that other, unmeasured factors could have influenced the variation found between groups.

In conclusion, the results of this study point to how packages communicate messages that allow consumers to identify with and differentiate between cigarette brands and thus are essential in the processes branding works through. [27] The results indicates further that a shift from branded to plain cigarette packaging could lead to a reduction in positive perceptions of cigarettes among adolescents, also in a context where marketing of tobacco as well as extensive use of innovative pack design to attract consumers is already highly

regulated. The result that respondents so clearly make distinctions regarding harmfulness and ease of quitting between brand varieties based upon colors and descriptors confirms findings from previous qualitative research in Norway [17] and points toward the conclusion that cigarette descriptors such as 'rounded taste' (in contrast to 'rough taste') and color codes such as 'gold' or 'pale blue' are perceived in a similar way as the prohibited terms 'light' and 'mild'. The use of these terms thus appears to violate the guidelines of the WHO Framework Convention on Tobacco Control treaty, which forbids information that directly or indirectly creates the false impression that a particular tobacco product is less harmful than other tobacco products.

Competing interests

None.

Funding

This study was funded in its entirety by the Norwegian Institute for Alcohol and Drug Studies (SIRUS).

Contributionship statement

Janne Scheffels designed the study, performed the main part of the analysis and drafted the paper. Ingeborg Lund performed some of the analysis and took part in drafting the paper.

Data sharing statement

No unpublished data from this study are available after the publication of this study.

References

1. Carter SM. The Australian cigarette brand as product, person and symbol. *Tob Control* 2003;**12**:iii79–iii86.
2. Wayne GF, Connolly G. How cigarette design can affect youth initiation into smoking: Camel cigarettes 1983–93. *Tob Control* 2002;**11**:i32–i39.
3. Anderson SJ, Glantz SA, Ling PM. Emotions for sale: cigarette advertising and women's psychosocial needs. *Tob Control* 2005;**14**:127–35.
4. Carpenter CM, Wayne GF, Connolly GN. Designing cigarettes for women: new findings from the tobacco industry documents. *Addiction* 2005;**100**:837–51.
5. Wakefield M, Morley C, Horan JK, et al. The cigarette pack as image: new evidence from tobacco industry documents. *Tob Control* 2002;**11**(suppl 1):i73–i80.
6. Pollay RW, Dewhirst T. The dark side of marketing seemingly 'light' cigarettes: successful images and failed fact. *Tob Control* 2002;**11**(1):18–31.
7. Thun MJ, Burns DM. Health impact of 'reduced yield' cigarettes: a critical assessment of the epidemiological evidence. *Tob Control* 2001;**10**(1):4–11.
8. Hecht SS, Murphy SE, Carmella SG, et al. Similar uptake of lung carcinogens by smokers of regular, light, and ultralight cigarettes. *Cancer Epidemiol Biomarkers Prev*, 2005;**14**:639–98.
9. Wilson N, Weerasekera D, Peace J, et al. Misperceptions of 'light' cigarettes abound: national survey data. *BMC Public Health* 2009;**9**:126.
10. Borland R, Fong GT, Yong HH, et al. What happened to smokers' beliefs about light cigarettes when 'light/mild' brand descriptors were banned in the UK? Findings from the International Tobacco Control (ITC) Four Country Survey. *Tob Control* 2008;**17**:256–62.

11. Mutti S, Hammond D, Borland R, et al. Beyond light and mild: Cigarette brand descriptors and perceptions of risk in the International Tobacco Control (ITC) four country survey. *Addiction* 2011;**106**;1166–75.
12. Ford A, Moodie C, Hastings G. The role of packaging for consumers products: understanding the move towards 'plain' tobacco packaging. *Addict Res Theory* 2012;**20(4):**339-347.
13. Hammond D, Dockrell M, Arnott D, et al. Cigarette package design and perceptions of risk among UK adults and youth. *Eur J of Public Health* 2009;**19**(6):631–37.
14. Wakefield MA, Germain D, Durkin SJ. How does increasingly plainer cigarette packaging influence adult smokers' perceptions about brand image? An experimental study. *Tob Control,* 2008;**17**:416–21.
15. Wakefield MA, Germain D, Durkin SJ. How does increasingly plainer cigarette packaging influence adult smokers' perceptions about brand image? An experimental study. *Tob Control,* 2008;**17**:416–21.
16. Moodie C, Ford A, Mackintosh AM, et al. Young people's perceptions of cigarette packaging and plain packaging: an online survey. *Nic Tob Res* 2012;**14**(1):98–105.
17. Scheffels J, Sæbø G. Perceptions of plain and branded cigarette packaging among Norwegian youth and adults: a focus group study. *Nic Tob Res* 2013, **15 (2)**: 450-456.
18. Hoek J, Gendall P, Gifford H, et al. Tobacco branding, plain packaging, pictorial warnings, and symbolic consumption. *Qualitative Health Research* 2012;**22**(5), 630–9.
19. Hoek J, Wong C, Gendall P, et al. Effects of dissuasive packaging on young adult smokers. *Tob Control* 2011;**20**:183–188.

20. Munafo MR, Roberts N, Bauld L, et al. Plain packaging increases visual attention to health warnings on cigarette packs in non-smokers and weekly smokers but not daily smokers. *Addiction* 2011:**106**(8):1505–10.
21. White CM, Hammond D, Thrasher JF, et al. The potential impact of plain packaging of cigarette products among Brazilian young women: an experimental study. *BMC Public Health* 2012;12.
22. Hammond D, Daniel S, White CM. The effect of cigarette branding and plain packaging on female youth in the United Kingdom. *J Adolesc Health,* 2012; **2(2)**:151-157.
23. Scheffels J. A difference that makes a difference: young adult smokers' accounts of cigarette brands and package design. *Tob Control* 2008;**17**(2):118–122.
24. Scheffels J, Lavik R. Out of sight, out of mind? Removal of point-of-sale tobacco displays in Norway. *Tob Control* 2013;**22**:e37-e42
25. Moodie, C., A. Ford, Young adult smokers' perceptions of cigarette pack innovation, pack colour and plain packaging. Marketing and Public Policy, Australasian Marketing Journal, 2011; **19(3)**: 174-180.
26. Gendall P, Hoek J, Edwards R, et al. A cross-sectional analysis of how young adults perceive tobacco brands: implications for FCTC signatories. *BMC Public Health*, 2012. 12:796.
27. Hulberg J. Integrating corporate branding and sociological paradigms: A literature study. *Journal of Brand Management*, 2006; **14** : 60-73

Figure legend

Figure 1 Examples of the three versions of cigarette packs.

Branded Plain with descriptors Plain without descriptor

Figure 1. Examples of the three versions of cigarette packs.

248x140mm (300 x 300 DPI)

The impact of cigarette branding and plain packaging on perceptions of product appeal and risk among young adults in Norway. A between-subjects experimental survey

Authors' names and affiliations

Janne Scheffels & Ingeborg Lund

Norwegian Institute for Alcohol and Drug Research (SIRUS)

Corresponding author

Janne Scheffels

Norwegian Institute for Alcohol and Drug Research (SIRUS)

PO Box 565, Sentrum

0105 Oslo, Norway

js@sirus.no

Tel +47 40631744

Word count: 3810

ABSTRACT

Objectives This study **e**xamined perceptions of cigarette packaging and the potential impact of plain packaging regulations. The hypothesis was that branded cigarette packages would be rated more positively than corresponding plain packs *with* and *without* descriptors.

Design Between-subjects experimental online survey. Male and female participants were separately randomized to one out of three experimental conditions: fully branded cigarette packs, plain packs with descriptors, and plain packs without descriptors asked to evaluate 12 individual cigarette packages. Participants were also asked to compare 5 pairs of packs from the same brand family.

Setting Norway

Participants 1010 youths and adults aged15-22.

Primary outcome measures Ratings of appeal, taste and harmfulness for individual packages. Ratings of taste, harm, quality, 'would rather try' and 'easier to quit' for pairs of packages

Results Plain with and without descriptors packs were rated less positively than branded on appeal (index score 1.63/1.61 vs 2.42, p<0.001), taste (index score 1.21/1.12 vs 1.70, p<0.001) and less harmful (index score 1.0.34/0.36 vs 0.82, p<0.001). Among males, the difference between the plain with and without descriptors versus branded condition was significant for appeal (index score 2.08/1.92 vs 2.58, p<0.005) and between the plain without descriptors versus branded condition was for taste (index score 1.18 vs 1,70, p<0.00). The pack comparison task showed that packs with descriptors suggesting a lower content of harmful substances, together with lighter colors, were more positively rated in the branded

Article summary

Article focus

- Cigarette packaging is an important component of tobacco marketing, and in recent years evidence supporting the potential public health benefits of plain packaging has grown
- This paper examines perceptions of branded and plain packaging among young adults in Norway

Key messages

- Findings indicate that branded cigarette packages communicate messages that allows consumers to identify with and differentiate between brands
- Plain packages were rated less positively than branded packages on a range of dimensions
- The results indicate that plain packaging can contribute to diminish the power of branding as promotion of tobacco products and counter misperceptions that some products are less harmful than others

Strengths and limitations

- The between-subjects design provides a qualitative overview of evaluations of a different branded cigarette packs, in addition to results on differences in perceptions of branded and plain packs.
- Respondents in the three conditions did not differ statistically from each other in terms of age, smoking status or gender, but other, unmeasured factors could have influenced the variation found between groups

compared to the plain condition on dimensions less harmful (β-0.77, 95% CI -0.97,-0.56), would rather try (β-0.32, 95% CI -0.50,-0.14) and easier to quit (β-0.58, 95% CI -0.76,-0.39).

Conclusion The results indicate that a shift from branded to plain cigarette packaging could lead to a reduction in positive perceptions of cigarettes among young people.

INTRODUCTION

In the process of building a brand, it is crucial to create the right product name and to develop a visual motif or logo that will be imprinted onto consumers' minds as associations with the brand that will differentiate it from competing products in the market. [1] In the marketing of tobacco, such 'cues' related to brand imagery are typically coded into the product's packet design and color scheme. Studies of documents from the tobacco industry have shown how cigarette branding has been used to target particular consumer groups, how branding may increase the appeal of smoking [2-4], and how considerable efforts have been put into developing cigarette packet designs that attract consumers [5].

Particularly in dark markets, cigarette pack design has become a main vehicle for tobacco marketing. Coloring and color descriptors are key measures used for communicating messages about the product, e.g to target a particular gender or to portray smoking in line with the desired brand image. [3] Shades of the same color and the proportion of white space on the package are commonly used to distinguish between variants of the same brand, with darker colors generally used to portray a stronger, full-flavored product, and lighter colors to communicate a brand of lower tar and nicotine content. As the color scale moves toward white, associations with cleanliness and a healthy product are targeted. [5] Brand descriptors and images have also been important elements in the tobacco industry's strategy of falsely reassuring consumers about the potential harm of their products. [6] Cigarettes labeled 'light' or 'mild' have been marketed as less harmful to health due to reductions in toxin exposure, an assertion that has been thoroughly repudiated by epidemiological data indicating that smoking these products has little or no health benefit [7] and, as smokers tend to compensate for reduced delivery of nicotine, tar delivery increases, effectually cancelling out the presumed benefits of 'low-tar' cigarettes. [8] Research has shown that many smokers falsely believe that cigarettes labeled 'light' or 'mild' actually deliver less tar and are less harmful to smokers

[9]. Furthermore, regulating the use of such descriptors does not seem to be sufficient to correct these beliefs. Studies from jurisdictions where regulations on misleading descriptors have been implemented have exposed that many smokers continue to believe that some cigarette brands are less harmful than others, and that these beliefs are associated with descriptive words and elements of package designs that have yet to be prohibited, including the names of colors. [10, 11]

In order to limit the package design opportunity of communication between tobacco producers and consumers (and potential consumers in particular), several jurisdictions have considered regulations on package design, [12] and Australia was the first country to implement plain packaging of tobacco products, in December 2012. While it is still early to draw conclusions about the real life effect of plain packaging, a growing body of experimental evidence supports the potential public health benefits of plain packaging. Studies have e.g demonstrated that pack colors and brand imagery such as symbols and graphics can influence consumers' perceptions of the risk involved in using tobacco products, [13, 14] and that the removal of brand images from cigarette packaging can reduce the appeal of packs and products. [15-17] Experimental research has also indicated that plain packaging can significantly reduce false beliefs about health risks and ease of quitting, [13, 18] promote cessation behavior [19] and increase the salience of health warnings. [20] Recent research has also indicated that removing descriptors from plain packs can decrease ratings of appeal, taste and smoothness further, and also reduce associations with positive attributes. [21, 22]

In Norway, qualitative studies have indicated that the power of tobacco branding remains strong [23], despite strict regulations on marketing. A relatively limited array of tobacco brands and pack designs are for sale, probably due to the size of the market as well as the regulatory environment. Since 1975, when all tobacco advertising was banned, a range of additional tobacco marketing restrictions have been implemented, including restrictions on

selling cigarette packages that because of 'unconventional design or an appearance can lead to increased sales' (1995), misleading brand descriptors (2003), and a complete point of sale display ban (2010). Combined with consistently high tobacco tax levels and other important judicial restrictions such as the ban on indoor smoking in public areas in 2004, these regulations on tobacco marketing have probably contributed to the reductions in daily smoking prevalence in recent years, as well as influenced the characteristics of the tobacco market.

The aim of the current study was to examine perceptions of cigarette packaging among young adults in a context where marketing is highly restricted and where pack designs are less innovative than in many other jurisdictions. More specifically, the aim was to examine the impact of color variations, imagery and brand descriptors on perceptions of appeal, taste, health risks and ease of quitting, the effect of removing these elements (i.e., plain packaging) on the same variables, and individual differences in perceptions of packaging.

METHODS

One thousand ten male and female smokers and nonsmokers, aged 15–22 years old, were recruited from TNS Gallup's online participant panel during 2011. The panel is representative of the population as regards demographical variables, panelists were invited into the survey with age and gender as inclusion criteria. All participants were provided with remuneration according to Gallup's standard procedures. This study received full clearance from the Norwegian Data Protection Official for Research, including ethical evaluation (project number 34433). The data collection had an experimental, between-subjects design; participants were randomly assigned to one of three pack conditions: branded, plain with descriptors or plain without descriptors, as illustrated in figure 1. While participants in the branded condition (1) were shown images of standard, fully branded cigarette packages, those

assigned to the plain with descriptors condition (2) viewed images of the same packs digitally altered to remove brand imagery and colors, while descriptors (i.e., 'rough taste' or 'white') remained on a plain, grey package. In the plain without descriptors condition (3), participants were shown packages similar to (2), in which descriptors had also been removed.

The studies mandating a grey/olive plain pack color made before the implementation of the Australian plain packaging legislation had not been done at the time we designed this study. The grey plain pack color was chosen based upon a common sense evaluation of grey as a color signifying 'indistinctive' and unappealing. The cupboards used to cover tobacco products in shops after the point-of-sale display ban was implemented in Norway usually has a similar grey color, [24] underlining perhaps the cultural connotations of this color in the local context that this study was undertaken in.

All packages included in the study were purposely selected from leading international and Scandinavian brand names to reflect key dimensions of interest in terms of the brand descriptors and brand imagery. For instance, brands that featured different color descriptors (e.g., red vs. gold), and flavor descriptors (e.g., rounded taste vs. rich taste) were selected. Packages that featured different brand imagery were also selected, including the use of different colors (e.g., red vs. white), and packages in different sizes (10s and 20s).

Both English and Norwegian language descriptors were present among the selected brands. English is a language spoken among a large majority of the population in Norway and in particular among young people. It is thus unlikely that the respondents had problems understanding the descriptor words in any of the languages. There were no statistically significant differences in the age, gender or smoker distributions of the participants according to pack condition. Overall, 79.5% were nonsmokers, and 41.8% of the participants were male. The age distribution showed 16.6% were 15–17 year-olds, 44.7% were 18–20 year-olds, and 38.7% were 21–22 year-olds.

Participants were given two tasks: the first task was an *individual pack rating*, and included 12 individual packs to be rated on perceived appeal, taste and harmfulness. In this section, males and females were shown different pack selections, the males' selection consisting of supposedly 'male-oriented' packs, and the females' selection consisted of supposedly 'female-oriented' packs. The distinction between male and female brands was based upon previous qualitative studies from Norway, [23, 17] as well as presumptions about gender-coded coloring (e.g., lighter pack = feminine) and descriptors (e.g., rough taste = masculine). Four of the brand varieties were the same for both genders. Images of all packs included are shown in tables 1 and 2. An automatic function securing that the packs were presented to individual respondents in a random order was programmed into the setup of the survey. The second task was the *direct pack comparison task*. In this task, participants were shown five pairs of packs from the same brand family with the intent of highlighting the role of descriptors and brand imagery in communicating relative differences between brands. Each pair, made up of packs from the individual pack selections, included a 'regular' brand variety, typically a darker pack containing a product with an average or somewhat high tar and nicotine content, and a 'lighter' variety, typically in a lighter package and with lower nominal levels of tar and nicotine. The paired packs were: Prince Rich Taste vs. Rounded Taste, Marlboro Red vs. Gold Original, Kent Original vs. HD Taste System, Lucky Strike Original vs. Blue and Petteroes Original vs. Lys Blå (Pale Blue). Participants were asked to evaluate the two packages against each other on variables aimed at tapping perceptions of health risk and addictiveness. The pack comparison task was identical for males and females, and there were only two experimental groups: branded and plain with descriptor. This was achieved by combining the participants in condition 3 (plain without descriptors) and condition 2 (plain with descriptors) into one group for this section of the questionnaire.

Measures

Subjects were asked to indicate how they perceived each individual pack with regard to three characteristics: appeal, taste and harmfulness. Questions were phrased as global comparisons, in the form 'Compared with other brands, how appealing (tasty, harmful) do you think this brand of cigarettes is?' The respondents were presented with four answer categories, in the form of: less appealing (tasty, harmful), no difference, or more appealing (tasty, harmful) and don't know'. Brandwise, perceived characteristics were recoded into binary variables contrasting those who answered that the brand was more appealing/tasty/harmful (1), with the rest (0). All binary categories were subsequently summed together, creating sum-score indexes for each brand characteristic across all packs, with higher scores signifying more positive characterizations.

In the direct pack comparison task, participants were asked to indicate which, if any, of the two packs in each pair they believed to taste better, to be less harmful, to be of better quality, and to be easier to quit. They were also asked which of the two they would rather try. After recoding the answers into binary variables contrasting those who chose the 'lighter' pack (1) with the rest (0), additive indexes were constructed for each dimension, across all pairs and both genders.

Additional variables used in analyses were age (coded into three age groups), smoking status and perceptions of risk to health from smoking. Smokers were defined as those who had smoked at all during the last 30 days. Respondents were asked whether they believed or knew that smoking could cause 12 different diseases: lung cancer, heart disease, stroke, mouth cancer, cancer of the larynx, emphysema, gangrene, impotence for male smokers, wrinkles and aging of the skin, harm to unborn children, lung cancer for nonsmokers breathing other people's cigarette smoke, and death. Response options were: Yes, no, and don't know. All positive answers were summed together to create a health risk awareness

index. For the logistic regression analyses, the index was recoded into a variable with three values (0–4, 5–8, 9–12).

Analysis

The analyses tested two primary hypotheses: (1) individual fully branded packages will be rated as significantly more appealing, better tasting and less harmful than corresponding plain packs *with* and *without* descriptors. (2) In a direct comparison of 'regular' and 'lighter' packs from the same brand family (e.g., Marlboro vs. Marlboro Gold), the lighter pack will more often be perceived as more appealing, better tasting and less harmful in the branded condition than in the plain (*with* descriptors only) condition. In the analyses of individual packages, logistic regression models were used to test for differences between experimental conditions adjusting for age, smoking status and health risk awareness.

In the instances where the pack selection included more than one variety of a specific brand, the condition 3 version of the second variety pack was altered to white (2 packs in females' selection) or black (3 packs in males' selection) instead of the standard grey. This was done in order to make the task meaningful for the respondents assigned to condition 3, who would otherwise have been asked to differentiate between identical packs. However, as these alternative plain packs made the results difficult to interpret, they are excluded from the presentation of individual scores in tables 1 and 2. In the calculation of mean pack rating index scores presented in table 3, the packs that were black or white in condition 3 were excluded for all conditions. This index is thus calculated from scores on 10 packages for females and 9 for males.

Linear regression analysis was used to test differences in index scores between conditions, adjusting for age, smoking status and health risk awareness. Linear regression analysis was also used to test significant differences between conditions on pack comparison index scores,

adjusting for age, gender, smoking status and level of health risk awareness. All analyses were conducted in SPSS version 19.0.

RESULTS

Individual pack ratings

Table 1 shows females' ratings of brand appeal, taste and harmfulness for individual packs. The highest *appeal* ratings in the branded condition were given for Marlboro Gold Original packs (10s and 20s), and Lucky Strike Original 10s. The packs that were given the highest ratings for *taste* by females were the two menthol brands: Salem and Marlboro White Menthol. On the harmfulness dimension, Prince Additive Free was most often rated positively by females, followed by Kent HD, Marlboro White Menthol and Marlboro Gold Original 10s. These are all brands that are sold in packets with colors close to white on a scale from darker to lighter packs. The highest occurrence of significant differences between conditions was found for harmfulness

Table 1. Female ratings for individual cigarette packages by experimental condition (n condition 1=221, n condition 2=195, n condition 3=172)

Females	 Prince Rounded Taste	 Prince Additive Free	 Salem Menthol	 Petterøes Lys blå	 Lucky Strike Original 10p	 Lucky Strike Blue	 Marlboro Gold Original	 Marlboro White Menthol	 Marlboro Gold Original 10p	 Kent HD	 Camel Filters	 Paramount Red American Blend
MORE APPEALING than other brands (% agree)												
1 Branded	28.6	26.5	16.5	14.3	32.6	22.8	36.5	21.9	36.2	28.1	22.8	7.4
2 Plain w/d.	21.2	20.2	9.9	7.3*	27.5	16.4	20.1*	17.3	25.9*	14.0*	14.6*	7.8
3 Plain no d.	20.6	-	4.1	8.1	28.7	18..1	25.9*	-	31.8	9.9*	11.7*	11.7
BETTER TASTE than other brands (% agree)												
1 Branded	18.8	15.1	31.1	8.8	19.3	11.6	22.6	33.8	23.0	19.0	14.8	3.3
2 Plain w/d.	15.6	14.6	17.7*	6.2	14.5	7.9	14.4*	27.4	17.6	14.6	10.4	3.1
3 Plain no d	7.8*	-	2.3*	7.0	18.8	12.9	18.2	-	15.9	8.8*	11.0	5.8
LESS HARMFUL than other brands (% agree)												
1 Branded	8.3	19.2	11.9	6.3	8.7	8.7	12.4	14.6	14.2	14.9	1.9	2.8
2 Plain w/d.	1.6*	15.5	6.8	4.2	2.1	2.6*	4.7*	10.0	5.7*	4.2*	3.1	1.0
3 Plain no d	1.2*	-	1.2*	1.2*	6.4	2.9*	4.4*	-	8.1	6.4*	2.3	2.3

Values with * indicate significant differences at the p<0.05 level between branded and plain conditions for individual packages in logistic regression models adjusting for age, smoking status and health risk awareness index score.

Table 2 shows males' individual pack ratings. In the branded condition, the pack rated as most *appealing* was the black Marlboro Gold Advance, followed by Lucky Strike Original (10s and 20s). The brands most often evaluated as *tasting better* than others were Prince Rich Taste and Camel Natural Flavor, both of which had descriptors focusing on flavor. Males most often rated white Marlboro Gold 10 as less harmful than other brands, followed by Camel Natural Flavor. Compared with the situation for females, significant differences between conditions were somewhat less common for males. This difference between the genders was particularly noticeable for perceived harmfulness, where the analysis showed significant differences between conditions only for two packages, compared to seven among females.

Table 2. Male ratings for individual cigarette packages by experimental condition (n condition 1=163, n condition 2=118, n condition 3=143)

Males	Prince Rich Taste 	Prince Golden Taste 	Prince Rounded Taste 	Petterøes Original 	Lucky Strike Original 10 	Lucky Strike Original 20 	Marlboro Filter cigarettes 	Marlboro Gold Advance 	Marlboro Gold 10-pakn 	Kent Surround Taste system 	Camel Natural Flavor 	Paramount Red American Blend 
MORE APPEALING than other brands (% agree)												
1 Branded	30.8	17.4	23.1	17.1	33.5	32.3	27.5	36.1	28.6	29.8	22.2	10.1
2 Plain w/d.	22.6*	21.6	19.1	8.5	38.5	31.4	13.8*	22.4*	37.4	16.8*	16.4	13.0
3 Plain no d.	17.5*	-	-	12.5	31.5	26.1	16.8*	-	25.2	7.7*	16.2	9.2
BETTER TASTE than other brands (% agree)												
1 Branded	22.5	18.0	18.4	11.4	20.3	20.9	17.6	19.0	21.0	12.6	22.9	5.7
2 Plain w/d.	25.0	21.6	25.2	1.7*	23.3	21.2	13.8	16.4	17.9	17.7	19.7	6.1
3 Plain no d.	9.9*	-	-	9.2	20.3	17.0	10.5	-	12.7*	2.8*	15.4	3.6
LESS HARMFUL than other brands (% agree)												
1 Branded	1.9	6.2	7.3	1.3	6.3	2.5	3.8	4.4	12.0	7.0	9.6	4.5
2 Plain w/d.	5.2	2.6	5.3	5.2	6.0	3.4	15.7*	1.7	4.3*	6.2	5.1	4.3
3 Plain no d.	4.2	-	5.6	0.7	5.6	4.2	1.4	-	3.5*	10.5	3.5	3.5

Values with * indicate significant differences at the p<0.05 level between branded and plain conditions for individual packages in logistic regression models adjusting for age, smoking status and health risk awareness index score.

Table 3 shows the index scores for appeal, taste and harmfulness by gender and experimental condition. Linear regressions were conducted with experimental condition as the main independent variable and each of the characteristics of appeal, taste and harmfulness as the dependent variable, adjusting for age, smoking status and health risk awareness. Plain packages received significantly fewer positive ratings from females on all three dimensions. Among males, the difference between the branded and both plain conditions was significant for perceptions of appeal, and between branded and plain, no descriptors for taste.

Table 3. Index scores of perceived positive brand characteristics by gender and experimental condition.

Experimental condition	Mean score					
	Girls			Boys		
	Appeal	Taste	Less harmful	Appeal	Taste	Less harmful
Branded packs	2,42	1,70	0,82	2,58	1,70	0,52
Plain, with descriptors	1,63**	1,21**	0,34**	2,08*	1,60	0,56
Plain, no descriptors	1,61**	1,12**	0,36**	1,92*	1,18*	0,41

Values with (*) indicate significant difference at the p<0.001 (**) or 0.05(*) level between experimental conditions for each smoker trait in linear regression models adjusting for age, smoking status and health risk awareness index score.

Pack comparisons

Statistical differences between conditions on the index score summing up 'light' pack choices across all pairs were observed for the dimensions 'less harmful', 'would rather try' and 'easier to quit', with larger proportions answering that they believed that the lighter pack variant fitted these descriptions (table 4). Smoking status was a significant confounder in all these models, implying that smokers more often chose the light pack as fitting these descriptions. Risk awareness contributed significantly to explain pack choice for harmfulness, gender had an impact on the willingness to try, and age influenced the perceptions of which pack was easiest to quit.

Table 4. Linear regression predicting viewing the lighter colored pack in a pair of two brand variants more positively regarding of taste, harm, quality, would rather try and easier to quit). Model adjusting for the following covariates: age, smoking status, gender and risk awareness (Beta and p-value of significant covariates listed in table).

Plain (ref: branded)	**Taste better**	**Less harmful**	**Better quality**	**Would rather try**	**Easier to quit**
Beta (β)	-0.12	-0.77	0.04	-0.32	-0.58
95% CI for β	-0.29, 0.06	-0.97, -0.56	-0.11, 0.18	-0.50, -0.14	-0.76,-0.39
P-value	0.191	<0.001	0.627	<0.001	<0.001
Moderators (β, significance)	Gender (ref: male) -0.14 (p<0.001)	Smoking status (ref: non-smoker) 0.77 (p<0.001) Risk awareness index 0.05 (p=0.049)	Age (ref: between 15 and 18) -0.11 (p=0.004)	Gender (ref: male) -0.15 (p<0.001) Smoking status (ref: non-smoker) 0.13 (p<0.001)	Age (ref: between 15 and 18) -0.10 (p=0.012) Smoking status (ref: non-smoker) 0.15 (p<0.001)

DISCUSSION

In this study, pack design influenced the way participating youths and young adults perceived cigarette brand characteristics. Among girls, the analysis across all individual packages showed that branded packages significantly more often were rated as appealing, as tasting better and as less harmful than plain packages both with and without descriptors. Boys rated branded packages more positively compared to plain packages both with and without descriptors for appeal, and more positively compared to plain packages without descriptors for taste. The pack comparison task indicated that the use of descriptors suggesting a lower content of harmful substances, together with light colors, affected consumers' perceptions of tobacco products. The 'lighter' packs were significantly more often selected as being less harmful, easier to quit and appealing (a product I would rather try) in the branded condition than in the plain condition. The strongest of these effects was found for perceptions of a less harmful product.

The pattern of how individual packages were evaluated in the branded condition clearly suggested that color, design elements and descriptors act together in a way that forms consumers' perceptions of product qualities. Females generally perceived white packs as more appealing while males typically preferred the darker packs, indicating that the tobacco producers' strategies for building associations and identification [4, 5] are successful also in a country where the marketing of tobacco products is very restricted. Results regarding perceptions of taste indicated that descriptors were an important dimension; brands more positively evaluated were those with flavor additives (menthol) or other references to flavor (natural flavor, rich taste). All packs in light colors or with descriptors such as 'additive free' were more positively rated regarding harmfulness.

Interestingly, even though the general pattern as expected was that removing descriptors from plain packages decreased positive perceptions of packs, the plain *without*

descriptor packs were in some of the analyses of individual packages rated more positively than the plain packs *with* descriptors. This pattern appeared to be most noticeable for strong brand names such as Marlboro or Lucky Strike. Other studies of plain packaging and descriptors have reported similar patterns [21, 22] and inferred that brand family names may become relatively more important in distinguishing between brands and promoting appeal in the absence of brand imagery and descriptors.

Few of the typically 'feminine' cigarette packs sold in other countries, such as packs that look like lipstick boxes or packs with typically feminine names such as e.g *Vogue* or *Slims*, are for sale in Norway, perhaps partly due to the regulations on 'unconventional' packaging. Still, Norwegian youth seem to have found their own way of differentiating between masculine and feminine packs. We observed that packs that are likely to appear more gender neutral in countries where such packs *are* at sale, e.g Marlboro Original Gold [21] seem to be popular among girls in Norway, probably partly because of a position as feminine [23]. This illustrates the power of packaging to communicate messages that allow consumers to identify with and differentiate between brands, also when more conspicuous designs and elaborate elements such as pack shape, opening methods or shape of the cigarette are not being used.

There was a tendency for males to demonstrate somewhat more stable views regardless of condition. This could indicate that pack design is less important for males' perceptions of brand characteristics; perhaps males are less interested in, and therefore less influenced by, the design of cigarette packs? It has been documented that the tobacco industry has made particular efforts to design cigarette packages more attractive for girls. [4] On the other hand, the shortage of significant differences between conditions among males could be the result of a very high degree of awareness of the differences between brand images, so that the brand associations stay on after only the brand name remains to identify the product. Previous

research has concluded both in favor [25] and against [26] the significance of gender on perceptions of pack design and plain packaging.

An intrinsic weakness in the study design is that all participants would have been quite familiar with the design of the branded cigarette packs, and may have formed ideas about the products and their qualities before they took part in the study. This possibility is augmented by the fact that the packs included in the samples tended to be quite popular and well-known. However, if respondents in the plain conditions let former ideas about brand characteristics influence their answers, it is likely that this would have worked to diminish the difference between the results in the different conditions more than if the participants were neutral from the start. Another possible limitation of this study is that the color used to represent plain packaging may have influenced respondents' perceptions in a different way than intended. Studies from other countries evaluating the suitability of different colors have e.g concluded that grey is perceived less negatively than brown. [25] This concern is to some extent reduced by findings from qualitative studies indicating that grey plain cigarette packages are perceived negatively in Norway. [17] The between-subject design also carries with it some challenges, predominantly the risk of uncontrolled variation between groups, or in this case, between conditions. Fortunately, the groups did not differ statistically from each other in terms of age, smoking status or gender, but it is of course possible that other, unmeasured factors could have influenced the variation found between groups.

In conclusion, the results of this study point to how packages communicate messages that allow consumers to identify with and differentiate between cigarette brands and thus are essential in the processes branding works through. [27] The results indicates further that a shift from branded to plain cigarette packaging could lead to a reduction in positive perceptions of cigarettes among adolescents, also in a context where marketing of tobacco as well as extensive use of innovative pack design to attract consumers is already highly

regulated. The result that respondents so clearly make distinctions regarding harmfulness and ease of quitting between brand varieties based upon colors and descriptors confirms findings from previous qualitative research in Norway [17] and points toward the conclusion that cigarette descriptors such as 'rounded taste' (in contrast to 'rough taste') and color codes such as 'gold' or 'pale blue' are perceived in a similar way as the prohibited terms 'light' and 'mild'. The use of these terms thus appears to violate the guidelines of the WHO Framework Convention on Tobacco Control treaty, which forbids information that directly or indirectly creates the false impression that a particular tobacco product is less harmful than other tobacco products.

Competing interests

None.

Funding

This study was funded in its entirety by the Norwegian Institute for Alcohol and Drug Studies (SIRUS).

Contributionship statement

Janne Scheffels designed the study, performed the main part of the analysis and drafted the paper. Ingeborg Lund performed some of the analysis and took part in drafting the paper.

Data sharing statement

No unpublished data from this study are available after the publication of this study.

References

1. Carter SM. The Australian cigarette brand as product, person and symbol. *Tob Control* 2003;**12**:iii79–iii86.
2. Wayne GF, Connolly G. How cigarette design can affect youth initiation into smoking: Camel cigarettes 1983–93. *Tob Control* 2002;**11**:i32–i39.
3. Anderson SJ, Glantz SA, Ling PM. Emotions for sale: cigarette advertising and women's psychosocial needs. *Tob Control* 2005;**14**:127–35.
4. Carpenter CM, Wayne GF, Connolly GN. Designing cigarettes for women: new findings from the tobacco industry documents. *Addiction* 2005;**100**:837–51.
5. Wakefield M, Morley C, Horan JK, et al. The cigarette pack as image: new evidence from tobacco industry documents. *Tob Control* 2002;**11**(suppl 1):i73–i80.
6. Pollay RW, Dewhirst T. The dark side of marketing seemingly 'light' cigarettes: successful images and failed fact. *Tob Control* 2002;**11**(1):18–31.
7. Thun MJ, Burns DM. Health impact of 'reduced yield' cigarettes: a critical assessment of the epidemiological evidence. *Tob Control* 2001;**10**(1):4–11.
8. Hecht SS, Murphy SE, Carmella SG, et al. Similar uptake of lung carcinogens by smokers of regular, light, and ultralight cigarettes. *Cancer Epidemiol Biomarkers Prev*, 2005;**14**:639–98.
9. Wilson N, Weerasekera D, Peace J, et al. Misperceptions of 'light' cigarettes abound: national survey data. *BMC Public Health* 2009;**9**:126.
10. Borland R, Fong GT, Yong HH, et al. What happened to smokers' beliefs about light cigarettes when 'light/mild' brand descriptors were banned in the UK? Findings from the International Tobacco Control (ITC) Four Country Survey. *Tob Control* 2008;**17**:256–62.

11. Mutti S, Hammond D, Borland R, et al. Beyond light and mild: Cigarette brand descriptors and perceptions of risk in the International Tobacco Control (ITC) four country survey. *Addiction* 2011;**106**;1166–75.
12. Ford A, Moodie C, Hastings G. The role of packaging for consumers products: understanding the move towards 'plain' tobacco packaging. *Addict Res Theory* 2012;**20(4):**339-347.
13. Hammond D, Dockrell M, Arnott D, et al. Cigarette package design and perceptions of risk among UK adults and youth. *Eur J of Public Health* 2009;**19**(6):631–37.
14. Wakefield MA, Germain D, Durkin SJ. How does increasingly plainer cigarette packaging influence adult smokers' perceptions about brand image? An experimental study. *Tob Control,* 2008;**17**:416–21.
15. Wakefield MA, Germain D, Durkin SJ. How does increasingly plainer cigarette packaging influence adult smokers' perceptions about brand image? An experimental study. *Tob Control,* 2008;**17**:416–21.
16. Moodie C, Ford A, Mackintosh AM, et al. Young people's perceptions of cigarette packaging and plain packaging: an online survey. *Nic Tob Res* 2012;**14**(1):98–105.
17. Scheffels J, Sæbø G. Perceptions of plain and branded cigarette packaging among Norwegian youth and adults: a focus group study. *Nic Tob Res* 2013, **15 (2)**: 450-456.
18. Hoek J, Gendall P, Gifford H, et al. Tobacco branding, plain packaging, pictorial warnings, and symbolic consumption. *Qualitative Health Research* 2012;**22**(5), 630–9.
19. Hoek J, Wong C, Gendall P, et al. Effects of dissuasive packaging on young adult smokers. *Tob Control* 2011;**20**:183–188.

20. Munafo MR, Roberts N, Bauld L, et al. Plain packaging increases visual attention to health warnings on cigarette packs in non-smokers and weekly smokers but not daily smokers. *Addiction* 2011:**106**(8):1505–10.
21. White CM, Hammond D, Thrasher JF, et al. The potential impact of plain packaging of cigarette products among Brazilian young women: an experimental study. *BMC Public Health* 2012;12.
22. Hammond D, Daniel S, White CM. The effect of cigarette branding and plain packaging on female youth in the United Kingdom. *J Adolesc Health,* 2012; **2(2)**:151-157.
23. Scheffels J. A difference that makes a difference: young adult smokers' accounts of cigarette brands and package design. *Tob Control* 2008;**17**(2):118–122.
24. Scheffels J, Lavik R. Out of sight, out of mind? Removal of point-of-sale tobacco displays in Norway. *Tob Control* 2013;**22**:e37-e42
25. Moodie, C., A. Ford, Young adult smokers' perceptions of cigarette pack innovation, pack colour and plain packaging. Marketing and Public Policy, Australasian Marketing Journal, 2011; **19(3)**: 174-180.
26. Gendall P, Hoek J, Edwards R, and McCool J. A cross-sectional analysis of how young adults perceive tobacco brands: implications for FCTC signatories. *BMC Public Health*, 2012. 12:796.
27. Hulberg J. Integrating corporate branding and sociological paradigms: A literature study. *Journal of Brand Management*, 2006; **14** : 60-73

Figure legend

Figure 1 Examples of the three versions of cigarette packs.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	5,8
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	*5*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5,14
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9,11,13,14
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17,18
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.