Preventive Medicine 67 (2014) 166–170

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Do colleagues influence our lifestyle: The matter of smoking, body mass index and leisure-time physical activity?

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ARTICLE INFO

Available online 26 July 2014

Keywords:
Cluster
Homophily
Lifestyle changes
Health care workers

ABSTRACT

Objective: Previous research has indicated that health behaviours tend to cluster in social networks, but few have studied the cluster effect in workgroups. We examined the effect of workgroups on current state and change in three indicators of health behaviours (smoking, body mass index (BMI) and physical activity). Further, we examined whether health behaviours of the respondents at group level predicted lifestyle changes.

Methods: In a prospective cohort (n = 4730), employees from 250 workgroups in the Danish eldercare sector answered questionnaires at baseline (2005) and follow-up (2006). Multilevel regression models were used to examine the effect of workgroups.

Results: Workgroups accounted for 6.49% of the variation in smoking status, 6.56% of amount smoked and 2.62% of the variation in current BMI. We found no significant workgroup clustering in physical activity or lifestyle changes. Furthermore, changes in smoking status (cessation) and weight gain were seen in workgroups with high percentage of smokers and high levels of BMI.

Conclusion: We found modest evidence for clustering of some health behaviours within workgroups, which could be due to social learning or selection into and out of workgroups. Future health promotion programmes at worksites should recognize the potential clustering of lifestyle behaviours within workgroups.

Introduction

Studies have addressed the relationship between work environment and health behaviours, including physical activity, weight change and smoking behaviour (Albertsen et al., 2004; Allard et al., 2011; Brisson et al., 2000; Kivimaki et al., 2006a; Kouvonen et al., 2005a,b; Lallukka et al., 2008). It has been suggested that health related behaviours, such as drinking, smoking and physical activity mediates the relationship between work environment and health outcomes (Albertsen et al., 2006; Brunner et al., 2007; Gimeno et al., 2009; Kivimaki et al., 2006b). Previous research, however, has focused on investigating the effect of work environment at the individual level. Consequently, few studies have addressed lifestyle and lifestyle changes at the workplace level.

The workplace has been seen as an ideal setting for the promotion of healthy lifestyles, as it provides easy access to large groups of people. However, most intervention projects focus on individual factors, thereby overlooking the potential importance of the workplace. Consequently, researchers are neglecting that the workplace in itself may have an influence on lifestyle and lifestyle changes. Workplaces represent a social setting where workers interact with co-workers, clients, and customers, potentially influencing the beliefs and behaviour of the worker. In Denmark it is common to bring your own lunchbox or eat in the company canteen while socializing with colleagues during lunch break. This can potentially lead to shared eating habits. Pachucki and colleagues found that some eating patterns (such as food preference) are socially transmissible in different social relationships (Pachucki et al., 2011).

Theory

Researchers addressing the clustering of health behaviours include Christakis and Fowler (2007, 2008) who modelled the spread of obesity and smoking cessation through social ties. They found that obesity and smoking cessation was "contagious" and suggested that individuals influence each other through norms and personal health behaviour. They found that an individual's risk of obesity increased by 57% if they had a friend who became obese during a specific time period. They

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http://dx.doi.org/10.1016/j.ypmed.2014.07.032

suggested that social ties could change the person's norms about obesity (such as the acceptance of obesity). The risk of continuing to smoke was estimated to decrease by 34% if a co-worker stopped smoking. While Christakis and Fowler did not study the possible effect of co-workers on obesity or physical activity, it seems possible that these contagion effects of co-workers might also be evident here.

Contagion effects for health behaviour could be explained through Social Learning Theory (SLT) (Bandura, 1986). Individual (health) behaviour according to Bandura (1977, 1986) is learned through the process of modelling the behaviour of others, and depends on the ability to execute the given behaviour (self-efficacy) (Christensen and Albertsen, 2005). Research on adolescents' health behaviours such as smoking habits and physical activity level has shown the importance of modelling others (Anderssen and Wold, 1992; Due and Holstein, 2000; Moore et al., 1991; Raudsepp and Viira, 2000). Research also indicates that social ties influence weight status and intention to lose weight, suggesting that social norms can be the cause of behavioural clustering within groups (Leahey et al., 2011). While SLT, in particular, has been applied to child- and adolescent health behaviour, its applicability is not limited to young populations (Delgado, 2009). SLT is used in person-to-person intervention perspective, where peers (across different age groups) serve as role models or guides to others.

In line with SLT and the network phenomenon assumption, workgroups may influence personal lifestyle and lifestyle changes; both directly and indirectly. As colleagues often work in close proximity, they may also function as models, whose behaviour can be observed, copied or influenced. For example, quitting smoking may be easier in a workgroup with few smokers, or if others are quitting smoking simultaneously. Health behaviours are also influenced indirectly by norms that are taken for granted and "goes without saying" in the group. On the other hand, it is also possible that individuals select themselves into a workgroup with similar health behaviours.

The aim of this explorative study was to investigate how much of the variation in lifestyle and changes in lifestyle can be explained by the workgroup. We also investigate, on workgroup level, whether change in lifestyle (body mass index (BMI), physical activity and smoking) is associated with average workgroup level of BMI, physical activity and smoking.

Material and methods

The Danish Elderly Care Cohort Study investigates the associations between health and work environment among health care workers employed in Danish municipalities. Data were collected at the municipal and individual level, while data for the intermediate level (workgroups) was created by aggregation from the individual level.

At baseline, 65 municipalities were invited to participate in the study and 36 agreed (55%). The baseline questionnaire was mailed to 12,746 employees in fall 2004/spring 2005. A total of 9949 employees (78%) returned the questionnaire. The follow-up was conducted in the fall of 2006 and included 35 of the original 36 municipalities plus five new municipalities — for a total of 15,697 employees of which 10,065 answered (64%). Less than 5% of the respondents had an ethnic background other than Danish. To examine the effect of workgroup, the current analyses only included the 4739 respondents (4555 women and 175 men) from 250 unique workgroups, who responded at both rounds and had not changed workgroup between baseline and follow-up.

The study was approved by the Danish Data Protection Agency and followed the regulations for data storage and protection. Participants were informed that participation was voluntary and that confidentiality was maintained by using numbers to identify participants.

Lifestyle factors

Outcomes were all self-reported and measured at baseline and follow-up with identical questions. Smoking was measured with the following question: "Do you smoke?" and three response categories were given ("yes", "used to, but not anymore" and "never"). The responses were subsequently dichotomized (current smoker vs. non-smoker, including previous smokers). Respondents were also asked how many cigarettes they smoked per day, which we grouped into the following categories: zero, between 1 and 10, between 11 and 19, and more than 20. BMI was calculated as weight in kilogramme divided by height in meters squared. Leisure time physical activity (LTPA) was assessed with a single question about the level of weekly physical activity within the past 12 months, with four response categories with increasing intensity and duration per week: (1) less than 2 hours of low-intensity activity; (2) 2 to 4 hours of low intensity activity; (3) more than 4 hours of low-intensity activity or 2 to 4 hours of intense activity; and (4) more than 4 hours of intense activity (Saltin and Grimby, 1968). Change in LTPA from baseline to follow-up was calculated as a difference score between −3 (decrease) and 3 (increase). A previous study has shown that workers in the Danish eldercare sector have similar tendencies as the general population with regard to alcohol consumption, body mass index, and physical activity. However, they tend to smoke more and eat less fruit and vegetables (Nabe-Nielsen et al., 2005).

Workgroups

Workgroups were defined to group the employees with people they interact with, and thereby have the potential to influence and be influenced by — regardless of whether they performed the same job or not. All employees were assigned unambiguously to only one workgroup based on information from the participating municipalities. Employees belonging to multiple workgroups were assigned to the group where they worked the majority of time. It should be noted, that some of the respondents were home care workers, who might have less interactions with their co-workers, while others were nursing home workers (or a combination of the two). Data at the intermediate level (workgroup level) was calculated based on aggregated data from the individual level. We excluded one workgroup which had only one employee, leaving a total of 250 workgroups. The workgroups consisted of between 2 and 98 members, with an average size of 19. A total of 54 workgroups had less than 10 members, while six had more than 50 members; the remaining 190 workgroups had between 11 and 49 members.

Statistical analyses

In descriptive analyses on individual level, we calculated means, standard deviation, and frequency distributions. To illustrate variation by workgroup, we calculated the mean score by workgroup quartiles. For each variable analysed, we categorized workgroups (weighted by size) after quartiles: the 25% workgroups with the lowest average; the 25% workgroups with second-lowest average; the 25% second-highest average; and the 25% with the highest average. We then calculated the means or frequency distribution within each quartile.

The main analyses concerned eight outcomes: (1) smoking status, (2) smoking cessation, (3) amount smoked, (4) smoking reduction, (5) BMI, (6) change in BMI, (7) LTPA and (8) change in LTPA. Using multilevel regression models, we assessed how much of the variation in BMI, smoking status, amount smoked and LTPA was explained by the workgroups. Also, we assessed how much of the variation in smoking cessation, smoking reduction, change in BMI and change in LTPA could be explained by the workgroups. Thus, we wished to compare the variance within the workgroups with the variance between the workgroups. We conducted generalized linear mixed models, which is an extension of generalized linear models that fits generalized linear models to correlated data, such as repeated measures. The model allows for ordinal response variables and incorporates random effects in the model. Results are presented as the proportion of variation explained by workgroup.

LTPA, change in LTPA and amount smoked were modelled as ordinal variables for which we used a cumulative probit link-function. For the binary outcome smoking, smoking cessation and smoking reduction we used a probit link-function. When addressing the issue of smoking cessation and smoking reduction we used a sub-dataset (N = 1618), which only included baseline smokers. BMI and change in BMI was modelled using a normal distribution. Significance of within cluster correlations was tested and based on the log likelihood ratio test statistic which was evaluated in a half-half mixture of $\chi^2(0)$ and $\chi^2(1)$ distribution (Verbeke and Molenberghs, 2000). Confidence limits for the within cluster correlation of BMI were estimated by simulation from the two-dimensional distribution. In all analyses workgroup was included as a random effect and occupational position and lifestyle factors were included as fixed effects. Additional analyses were conducted with gender, age, and cohabitations status (living with spouse/partner or living alone) included as additional fixed effects. No adjustment was made for income as most of the respondents were health care workers and public employees, thereby limiting the variation in revenue. We also conducted the analyses separately in workgroups with less than 10 members to see if the effects were stronger in smaller groups.

Furthermore, we conducted linear regression analyses to investigate whether: (1) the percentage of smokers in the workgroup predicts change in smoking status; (2) the average body mass index in the workgroup predicts weight change (change in BMI); and (3) average physical activity level predicts change in physical activity. To avoid response bias introducing spurious associations, we calculated the number of smokers, levels of body mass index and physical activity as the average of baseline and follow-up values. In other words, we looked at the association between change in score and average score (Bland and Altman, 1986). Potential non-linear effects were evaluated through quadratic terms; these were significant with regard to smoking status. In the case of quadratic effects, we centralized the variable for average share of smokers to avoid issues with multicollinearity. All the statistical analyses were performed with SAS Proc Glimmix and Proc GLM, version 9.2 (SAS Institute).

Results

Table 1 presents descriptive statistics of the participant and workgroups at baseline and follow-up. On average, the respondents were 46.5 years old and had worked at their current workplace for approximately 9.5 years at baseline. 82% of the respondents worked as health care workers, while approximately 7% were managers and 10% held another type of work position (such as janitor and secretary). Respondents had an average baseline BMI of 24.91, which increased to 25.15 at follow-up. Of the respondents who smoked at baseline, 13.75% had quit by the time of follow-up. The analyses on workgroup level illustrate workgroup variation for some variables. For example, in the quartile of workgroups with lowest smoking, only 17% of employees smoke, while 52% smoked in the quartile of workgroups with highest level of smoking.

Table 2 presents the results from the multilevel regression models, showing how much of the variation in each outcome that is explained by workgroup. Three of the eight outcomes were significant at the 0.05 level. Specifically, we found that 6.49% of the variation in baseline smoking status ($p < 0.0001$; 95% CI: 4.46–10.22), 6.56% of the variation in amount smoked ($p = < 0.0001$; 95% CI: 4.59–10.09) and 2.62% in BMI ($p = 0.0002$; 95% CI: 1.20–3.97) was explained by workgroup. Also, 1.11% of the variation in LTPA was explained by workgroup, albeit only borderline significant ($p = 0.0620$; 95% CI: 0.43–6.77). In small

Table 1
Descriptive statistics of the population and the workgroups at baseline and follow-up. The Danish Elderly Care Cohort Study, 2004–2006.

Variable	Individual level				Workgroup level			
	%	Mean (S.D.)	%	Mean (S.D.)	Mean score by workgroup quartile			
					First Quartile	Second Quartile	Third Quartile	Fourth Quartile
	Baseline (n = 4730)		Follow-up (n = 4730)		Baseline (n = 4730)			
Women	96.30	.		.	100%	100%	97.02%	88.26%
Men	3.70	.	.	.	0%	0%	2.98%	11.74%
Age	.	46.46 (8.86)	.	48.06 (8.85)	43.44	45.73	47.20	49.44
Number of years at current workplace[a]	.	9.42 (8.23)	.	.	6.04	8.48	10.18	12.89
Type of work position								
Managers	7.29	.	8.60	.	7.05%	6.49%	7.18%	8.44%
Health care workers	82.33	.	81.25	.	86.24%	83.4%	81.5%	78.26%
Other (e.g. janitors, secretaries)	10.38	.	10.15	.	6.71%	10.11%	11.32%	13.29%
BMI (kg/m^2)[b]	.	24.91 (4.19)	.	25.15 (4.36)	23.45	24.51	25.22	26.45
BMI category								
Normal	58.99	.	.	.	62.80%	57.45%	57.09%	58.68%
Overweight	29.63	.	.	.	25.87%	31.21%	31.01%	30.35%
Obese	11.38	.	.	.	11.33%	11.33%	11.89%	10.96%
Change in BMI (kg/m^2)[c]	.	.	.	0.23 (1.60)	.	.	.	.
Change in BMI (%)[c]								
Unchanged weight	.	.	72.04	.	74.5%	73.49%	73.34%	67.09%
Weight gain between 5 and 10%	.	.	12.17	.	7.56%	12.44%	12.65%	15.96%
Weight gain above 10%	.	.	5.95	.	2.19%	3.52%	6.19%	11.84%
Weight loss between 5 and 10%			6.83		10.02%	7.3%	5.73%	4.13%
Weight loss above 10%	.	.	3.01	.	5.74%	3.25%	2.09%	0.99%
Smoke status[d]								
Smoker	34.45	.	31.69	.	16.95%	29.33%	38.60%	52.37%
Smoking cessation[e]								
Ex-smoker	.	.	13.75	.	0%	6.03%	15.38%	33.25%
Smoking cessation by work position[e]								
Managers			32.18		.	.	.	
Health care workers			12.52		.	.	.	.
Other (e.g. janitors, secretaries)	.	.	14.19	.	.	.	.	.
Physical activity[f]								
Physical inactive	3.95	.	.	.	3.56%	3.36%	3.72%	5.14%
Light activity 2–4 h. pr. week	41.59	.	.	.	41.89%	43.67%	40.26%	40.56%
Light activity 4+ h. pr. week	49.86	.	.	.	49.52%	49.61%	50.82%	49.49%
Stenuous activity more than 4+ h. pr. week	4.60	.	.	.	5.03%	3.36%	5.19%	4.81%
Change in physical activity[g]								
Decreased level of physical activity	.	.	20.71	.	31.66%	22.12%	18.21%	11.16%
Unchanged level of physical activity	.	.	61.93	.	59.79%	62.47%	63.32%	62.11%
Increased level of physical activity	.	.	17.36	.	8.55%	15.41%	18.47%	26.73%

[a] 53 missing responses.
[b] 187/205 missing responses.
[c] 309 missing responses.
[d] 34/57 missing responses, full dataset.
[e] In a subset of baseline smokers, 18 missing responses.
[f] 75 missing responses.
[g] 162 missing responses.

Table 2
Total variance explained by workgroup [95% CI = confidence intervals]. The Danish Elderly Care Cohort Study, 2004–2006.

Response variable[a]	Total variance explained (%)[b, c]	95% CI	p-Value[d]
Current smoking	**6.49%**	4.46–10.22	<**0.0001**
Amount smoked	**6.56%**	4.59–10.09	<**0.0001**
Smoking cessation[e]	4.50%	1.57–33.64	0.0955
Smoking reduction[e]	0.40%	0.04–81.26	0.4116
Leisure-time physical activity	1.11%	0.43–6.77	0.0620
Change in physical activity	0.95%	0.30–12.19	0.1127
Body mass index	**2.62%**	1.20–3.97	**0.0002**
Change in body mass index[f]			

Significant results are presented in boldface.
[a] Adjusted for occupational position and lifestyle factors.
[b] Calculated as: (estimate / estimate + residual) when dist = normal.
[c] Calculated as: (estimate / 1 + estimate) when dist = mult.
[d] p-Values are based on the log likelihood ratio test statistic evaluated in a half–half mixture of $\chi^2(0)$ and $\chi^2(1)$ distribution. Only 245 workgroups.
[e] Only baseline smokers (N = 1608).
[f] No convergence.

workgroups, only the variation in smoking and amount smoked was significantly explained by workgroups (results not shown). We found similar results in additional analyses where gender, age and cohabitation status were included as fixed effects (results not shown).

Results from the linear regression analyses are presented in Table 3. We found support for two of our three tested outcomes. Specifically, we found that change in BMI within the workgroup was associated with average BMI in the group ($p = 0.0367$) so that weight gain was seen in workgroups with high BMI levels. Quadratic effects showed that smoking cessation was indeed predicted by the percentage of smokers in the group, in that smoking cessation happened in the workgroups with the largest share of smokers ($p = 0.0258$). However, change in LTPA was not associated with the average activity level in the group.

Discussion

The purpose of this study was to investigate the importance of workgroups with regard to health behaviours and lifestyle changes. We investigated whether workgroups would account for part of the variation within health behaviours and lifestyle changes. We found evidence for cluster effects regarding current health behaviours; part of the variation in BMI, smoking status and amount smoked was explained by workgroups (2.62%, 6.49% and 6.56%, respectively). Workgroups explained little of the variation in LTPA. With regard to changes in lifestyle, we found no significant effect of workgroups on variation in smoking cessation, smoking reduction, change in BMI, or change in physical activity. We did find that workgroup weight change depended on the average level of BMI in the group. Also, workgroup smoking cessation was seen in groups with larger shares of smokers. However, the average LTPA level did not predict change in LTPA level.

Christakis and Fowler (2007, 2008) found clustering effects for obesity and smoking cessation. Other researchers (Cohen-Cole and Fletcher, 2008a,b; Lyons, 2011) have suggested that the association could be explained by shared environmental factors and a tendency of forming relationships with people who have similar characteristics (homophily). Subsequent sensitivity analyses of the original studies found that the findings regarding obesity and smoking were reasonably robust to latent homophily and unmeasured environmental factors (VanderWeele, 2011). Another study using the methods of Christakis and Fowler found that attributes such as acne, height and headaches also seemed to spread through social ties (Cohen-Cole and Fletcher, 2008a). This has led some authors to question the interpretation of the original findings (Cohen-Cole and Fletcher, 2008a) while others conclude that the original findings of contagion effects cannot be dismissed (VanderWeele, 2011).

A potential advantage of our study is the use of a different methodology. Similar to Christakis and colleagues, our baseline might be influenced by homophily, but in our design, clustering of change could not have been explained by homophily. Since we only found significant effect of workgroup on baseline health behaviour, our study cannot rule out homophily as an explanation of the clustering of health behaviours. To reduce the risk of residual confounding we controlled for occupational position, lifestyle factors, and age, gender and cohabitation. Thus, the risk of confounding due to shared environmental factors seems limited in our study, although we did not have any data on alcohol use. However, it cannot be ruled out, that other factors, which we did not adjust for, could lead to residual confounding.

The relative short time between baseline and follow-up may provide us limited power to detect change in health behaviour. However, such a prolonged time frame would also have limited the number of employees remaining in the same workgroup. Among the other limitations of our study is the use of self-reported data. Also, for the workers in the home care units, contact with co-workers, and thus co-worker influence, may be limited. Unfortunately, the study questionnaire did not allow us to measure collegial ties. However, it is possible that we would find stronger cluster effects in teams with stronger interaction. Finally, the homogeneity of the sample (workers in the eldercare sector) was useful for reducing many potential confounders, but may limit the generalizability of the results. A final issue concerns workgroup size; Christakis and Fowler found an effect of co-workers on smoking cessation in small firms (up to six employees) but not in large firms (Christakis and Fowler, 2008). This may be due to the environment in larger firms, which provides more opportunities to find co-workers with similar health behaviour. However, in sensitivity analyses, we found no effect of workgroup on smoking cessation when restricting our analyses to groups with less than 10 members.

Conclusions

We found modest evidence for clustering in baseline smoking, amount smoked and BMI within workgroups. This could be due to social learning or selection into and out of workgroups. Furthermore, we saw weight increase in workgroups with high average BMI and smoking cessation in workgroups with a large number of smokers. Enhanced understanding and recognition of these lifestyle cluster effects may improve future health promotion programmes at worksites.

Conflict of interest statement

The authors declare that there are not conflicts of interest.

Table 3
General linear model results for associations between outcome and explanatory variables. The Danish Elderly Care Cohort Study, 2004–2006.

Outcome	Explanatory variable	Estimate	Std. error	p-Value
Workgroup change in BMI	Workgroup BMI average	0.0411	0.0195	**0.0367**
Workgroup change in LTPA	Workgroup LTPA average	0.0184	0.0771	0.8113
Workgroup change in smoking status	Workgroup percentage of smokers	−0.0335	0.0285	0.2408
Workgroup change in smoking status	Workgroup percentage of smokers squared[a]	−0.0242	0.0284	**0.0258**

Significant results are presented in boldface.
[a] Potential non-linear effect were evaluated through quadratic terms.

Acknowledgment

The authors wish to thank Vilhelm Borg and Birgit Aust for their contribution to the design of the cohort study and the data collection. The cohort study was financed by the Danish Government through a grant (17.21.02-50) to the National Research Centre for the Working Environment. The writing of this manuscript was funded by a grant (#40-2009-09) from The Danish Working Environment Research Fund. The funding sources did not partake in the design, interpretation of the results, writing of the manuscript, or decisions regarding publication.

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