Effects of workplace skin cancer screenings on preventive and risk behaviour

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Abstract

Aim Skin cancer is the most prevalent cancer in western countries and is associated with a high burden of disease. Skin cancer screenings can help detect cancer at an early stage and thus allow for better treatment. We aimed to analyse the impact of workplace skin cancer screenings on prevention behaviour and potential spillover effects on non-participants.

Subject and methods Participants of workplace skin cancer screenings completed questionnaires at 0, 3 and 12 months on knowledge about and attitudes toward skin cancer and prevention behaviours. Effects over time were compared using McNemar tests. For additional analyses we performed logistic regression analyses.

Results Of the 998 participants (44.7% women, mean age 43.3 years), 26.7% had never attended a skin cancer screening. The proportion of participants seeking shade for UV protection and the number of visits to dermatologists and general practitioners increased significantly in the year following workplace screening ($p < 0.05$). Two thirds (66.4%) recommended skin cancer screenings to others and at least 39.2% of them were sure that this recommendation was followed. Characteristics associated with participants' recommendation for screening included female gender (odds ratio: 1.62), older age (odds ratio: 1.02), and lower education (odds ratio: 1.40).

Conclusion Workplace screenings can complement routine skin cancer screenings. They inform participants about the existence and benefits of screenings and may have spillover effects for peers. They can also serve as another source of information on prevention and risk behaviours.

Keywords Workplace · Prevention · Skin cancer · Screening · Risk behaviour

Background

The term skin cancer encompasses all malignant tumours of the skin, mainly cutaneous melanoma, basal cell carcinoma and squamous cell carcinoma. All types of skin cancer are associated with a disease burden, as they can lead to disfigurement and are potentially life threatening. With a steadily increasing incidence in recent decades, it is the most common cancer in most western countries (Global Cancer Observatory 2018). Since skin cancer predominantly progresses slowly and offers good chances of cure when treated

at an early stage, the need for an early detection programme is clear (American Cancer Society 2018).

In the USA, the American Academy of Dermatology has offered annual screenings since 1985 for the entire population (Geller et al. 2002). A few years later, the Euromelanoma campaign was launched in Europe following a similar approach (Stratigos et al. 2012). By 2011, 260,000 examinations had been performed in 33 European countries. In contrast to these campaigns which offer screenings only on some days, Germany is the only country with a population-based programme for the early detection of skin cancer offered year-round and covered by statutory health insurance (SHI). Following a pilot study in 2008, routine skin cancer screening (rSCS) was launched with the aim of shifting the time and stage of diagnoses and thus enabling early starts of therapy and improving the chances of cure and survival (Gemeinsamer Bundesausschuss 2019).

Both the rSCS and the screening campaigns in Germany are prevention programmes without central appointment

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organisation or mailing of invitations. People with insufficient health literacy tend to request less information on health behaviour or prevention services (Shneyderman et al. 2016). This leads to a lack of knowledge on the concept of screening as an intervention for early detection of diseases before symptoms occur (von Wagner et al. 2011; Smith et al. 2013; Shneyderman et al. 2016). Thus, the risk of missing preventive interventions increases with decreasing health literacy (Kickbusch 2013), which has already been demonstrated for mammography and influenza vaccinations (Bennett et al. 2009; White 2008; Sudore et al. 2006). For Germany, this results in a potential access barrier due to inadequate health literacy in approximately 50% of the population (Sørensen et al. 2015).

In addition, there is a wide range of studies at the international level addressing potential factors which could influence participation in preventive measures. All studies revealed a positive association between a high level of education, occupation, wealth, high income, and a healthy lifestyle (physical activity, diet) with participation (Damiani et al. 2012; Walsh et al. 2011; Seidel et al. 2009; dem Knesebeck 2009; Bertaut et al. 2018; Wee et al. 2005, 2005; Shapiro et al. 2001a; Lorant et al. 2002; Frederiksen et al. 2010; Bennett et al. 2009; Doubeni et al. 2009). Furthermore, some studies report an increased probability of participation in a particular prevention programme among people who have previously used other prevention interventions (Shapiro et al. 2001b; Sieverding et al. 2010; Bertaut et al. 2018; Eichholzer et al. 2016). Regarding rSCS, there is little research on factors associated with participation. One study found that the use of protective measures (sunscreen, seeking shade, and wearing long clothes), as well as the sociodemographic characteristics of older age, higher education, and higher income were associated with participation in skin examinations (Santmyre et al. 2001b). In contrast, the likelihood of being diagnosed with skin cancer in advanced stage and thus less favourable prognosis is inversely correlated with sociodemographic characteristics (Idorn and Wulf 2014; Birch-Johansen et al. 2008; Abdel-Rahman 2020). Thus, it can be assumed that a relevant proportion of people who would benefit most from screening interventions are not reached by the current concept of rSCS (Bennett et al. 2009; Berkman et al. 2011).

As a complementary measure to rSCS, some companies in Germany offer their employees total-body skin examinations (TBSE). These TBSE are organised and advertised by the companies and performed directly at the workplace. Therefore, participants do not need to actively inform themselves about the offer or make a long-term appointment outside their working hours. This approach may reduce the self-selection of eligible people, determined by a lack of leisure time during office hours, health literacy or other barriers to access. To our knowledge,

there has been no study yet on the effects of TBSE in the workplace in Germany. To close this research gap, our study had a threefold aim: (1) to examine the participation rate of TBSE participants in rSCS; (2) to compare risk and preventive behaviour related to skin cancer before and after TBSE; (3) to assess spillover effects on non-participants.

Methods

Data sources and participants

To assess the effect of workplace skin screenings, we conducted this longitudinal observational study in cooperation with Heigel Healthcare, a company providing workplace examinations.

The study participants were recruited in companies that are clients of Heigel Healthcare and offer a workplace TBSE to their employees. On the day of examination, all employees were personally informed about the accompanying study. If they were aged 18 years or older, they were eligible to participate and received a questionnaire to complete and return before the beginning of examination (T1). However, participation in the study was not a prerequisite for the skin examination.

Study participants received two further questionnaires 3 months (T2) and 12 months (T3) after the skin examination. The content of the T2 questionnaire is not addressed in this study. The questionnaires for the second and third survey were sent by post with an enclosed self-addressed and prepaid envelope. Reminder letters were sent after 2 weeks of non-response.

At all three survey times, information was collected on attitudes towards prevention measures, knowledge about the prevention programmes offered by the SHI, and their personal use in everyday life. More precisely, the survey asked how often the general practitioner and dermatologist had been consulted in the last year (0, 1–2, 3–5, 6–10, > 10 times) and how regularly preventive measures from different specialties were used (regularly, irregularly, once, never).

In addition, information was requested on the personal risk and preventive behaviour regarding skin cancer: sunburns, UV exposure behaviour, participation in other preventive measures and family history of skin cancer. At T1, we also collected sociodemographic data. During the examinations, personal skin cancer risk factors and clinical parameters such as sun-reactive skin type (Fitzpatrick 1988), sunburns (in childhood), family history, and UV exposure at work were assessed. These were also included in the analyses.

Ethics

All participants were enrolled in the study between June and December 2015 and provided written informed consent. The last patient out was in February 2017. The approval of the ethics commission of the local medical association was obtained.

Statistical methods

First, we analysed all variables descriptively with percentages for categorical variables and mean, median, and standard deviation for continuous variables. Possible associated factors with the participation in rSCS before TBSE were analysed with a multivariable logistic regression model. The dependent variable was *participation in rSCS ever (yes/no)* at T1. Independent variables included in the model were *sociodemographic characteristics* and *individual risk factors*. In this analysis, we included participants older than 34 years, as this is the age limit for participation.

Differences in risk and preventive behaviour before (T1) and after (T3) the TBSE were examined by McNemar test. The McNemar test is testing for consistency in responses across two variables within the same individual. Significant *p* values indicate a directional shift in the bivariate variables over time. Percentage changes were calculated to specify the increase of the proportions.

Possible associated factors with the recommendation of rSCS to peer groups were analysed with a multivariable logistic regression model. The dependent variable was the *recommendation of routine skin cancer screening to others (yes/no)* at T3. Independent variables included in the model were *sociodemographic characteristics* and variables on *individual risk behaviour*. Schooling was dichotomised to secondary school (low educational level) and high school. Assumptions of the logistic regression model were checked to be satisfied. To investigate multicollinearity, correlations between predictor variables were examined. In addition, linearity was tested using the Box-Tidwell procedure (Box and Tidwell 1962).

A *p* value less than 0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics v.25 (Armonk, NY, USA).

Results

Of 4035 people enrolled during the screening phase, 1409 (34.9%) took part in the present study. At T3, 1002 people (73.8%) completed the follow-up questionnaires. After plausibility check, completed questionnaires were evaluable for 998 participants. More men (55.3%) and people with high school education (59.2%) participated in the study.

The mean age was 43.3 years (range 19–65 years). Women were younger with a mean age of 39.8 years compared to 46.2 years in men. Most participants (92.2%) were insured by SHI (Table 1). There were no significant differences in sociodemographic characteristics between the dropouts and the participants who completed all questionnaires.

A large proportion of participants had skin type II (60.2%) or skin type III (34.3%). Most participants (85.8%) had sunburns in childhood but only few (13.7%) reported sunburns more than once a year (see Table 1). The majority (73.3%) participated in rSCS at least once in their lifetime before TBSE.

For the participants older than 34 years, we analysed associated factors with rSCS participation before the TBSE. Assumptions for logistic regression were fulfilled (particularly no multicollinearity among the independent variables), with an explained variance of 15%. Age as the only sociodemographic variable was significantly associated with the participation in rSCS in this cohort, with an adjusted odds ratio (adj. OR) of 1.03 (95% CI [1.02, 1.04]; *p* < 0.001), meaning higher participation rates at higher age. Several sunburns per year (adj. OR = 0.59; 95% CI [0.28, 1.21]; *p* = 0.018) and regular sunbed use (adj. OR = 0.20, 95% CI [0.07, 0.62]; *p* = 0.005) were associated with lower participation rate in rSCS when compared to no sunburns and no sunbed use, respectively. Participation in other cancer screenings (adj. OR = 2.38; 95% CI [1.63, 3.48]; *p* < 0.001) and in dental check-ups (adj. OR = 2.39; 95% CI [1.69, 3.39]; *p* < 0.001) were highly associated with the participation in rSCS (Table 2).

At T1 and T3, most participants reported using at least one UV protection, only 4.0% [2.9, 5.5] and 3.9% [2.8, 5.3], respectively, reported not using any. The proportion of participants seeking shade for UV protection increased significantly between both time points by 5.5%, from 597 to 630. The number of consultations at dermatologists and general practitioners increased also significantly, with *p* < 0.001 and *p* = 0.024, respectively. At T1, 671 subjects had not consulted a dermatologist once. This number decreased to 50 at T3, a decrease of 92.6%. Sunbed use was already low before TBSE and did not change significantly. Participation rates in other preventive examinations were similarly high in T3 for the last 12 months as in T1 for at least once in the lifetime (Table 3).

Most participants had a positive attitude towards preventive medical examinations and agreed with the statement that they are reasonable for everyone and should be used. There were no significant differences between T1 (97.2%) and T3 (96.7%). More than half of the participants (54.3%) talked about rSCS with their peers after the TBSE (Fig. 1, appendix). About two thirds (66.4%) recommended the rSCS to others. At least 39.2% of them were confident that the recommendation was followed

Table 1 Sociodemographic characteristics of $N=998$ participants completing questionnaires at all three time points (at T1) and their risk factors in the examination

Characterisation of participants					
			<i>n</i>	<i>%</i>	
Sex	Male		552	55.3	
	Female		446	44.7	
School education	Secondary school		405	40.8	
	High school		588	59.2	
Health insurance	Statutory		911	92.2	
	Private		77	7.8	
Age (years)	Mean (SD)	Minimum	Median	Maximum	
Male	46.2 (9.7)	19	48	65	
Female	39.8 (9.7)	18	39	60	
Total	43.3 (10.2)	18	44	65	
Risk factors and behaviour (examination)					
			<i>n</i>	<i>%</i>	
Sun reactive skin type	Skin type I		39	3.9	
	Skin type II		601	60.2	
	Skin type III		342	34.3	
	Skin type IV/V		16	1.6	
Sunburns	Never		458	46.7	
	Once a year		389	39.7	
	> once a year		134	13.7	
Sunburns in childhood	Yes		848	85.8	
Sunbed use	Sunbed use - never		874	92.6	
	Sunbed use - sometimes		62	6.6	
	Sunbed use - regularly		8	0.8	
Family history	Melanoma		46	4.6	
	Non-melanoma skin cancer		109	10.9	
UV exposure at work	Yes		54	5.4	
Participated in skin cancer screening	Yes, at least once in lifetime		715	73.3	
Participation in other cancer screenings	Yes, at least once in lifetime		873	87.5	
Participation in dental check-up	Yes, at least once in lifetime		902	90.4	

n = number of participants, SD = standard deviation

by at least some of their peers. For the analysis of factors associated with the recommendation of rSCS to others, the assumptions of a logistic regression were fulfilled, yielding an explained variance of 6.4%. The sociodemographic variables of sex, age, and school education were significantly associated with the recommendation of rSCS to others. Female participants were more likely to recommend rSCS (adj. OR = 1.62; 95% CI [1.17, 2.24]; $p=0.003$), whereas participants with a high school education recommended the screening less often (adj. OR = 0.60; 95% CI [0.44, 0.83]; $p=0.002$). The older the participants were, the more often they recommended rSCS (adj. OR = 1.02; 95% CI [1.01, 1.04]; $p=0.002$). Individual preventive and risk behaviour did not significantly influence the recommendation to others (Table 4).

Discussion

The aim of the current study was to assess the long-term effects of workplace skin cancer screenings on preventive behaviour and spillover effects on non-participants. To this end, participants were asked to give follow-up information after 12 months. This research is of particular interest since very little is known about the lasting effects of secondary prevention of skin cancer and the impact on peers. The results should provide more insights into the potential of such skin cancer screenings beyond the identification of current skin lesions. The results show that in fact, some long-lasting effects of the TBSE were identified.

Table 2 Associated factors with the participation in routine skin cancer screenings covered by statutory health insurance before the workplace total-body skin examination (T1). Results of binary logistic regression analysis ($n = 752$; aged >34 years)

Variable categories	adj. OR (95% CI)	<i>p</i> value
Sex - male*		
Sex - female	1.29 [0.97, 1.72]	0.081
Age (continuous variable in years)	1.03 [1.02, 1.04]	< 0.001
School education - secondary school*		
School education - high school	1.17 [0.90, 1.53]	0.239
Sun reactive skin type - type I*		
Sun reactive skin type - type II	0.45 [0.22, 0.91]	0.027
Sun reactive skin type - type III	0.59 [0.28, 1.21]	0.146
Sun reactive skin type - type IV/V	0.44 [0.15, 1.30]	0.136
Sunburn - never*		
Sunburn - once a year	0.80 [0.60, 1.06]	0.115
Sunburn - several times per year	0.59 [0.28, 1.21]	0.008
Sunbed use - never*		
Sunbed use - sometimes	0.88 [0.55, 1.40]	0.587
Sunbed use - regularly	0.20 [0.07, 0.62]	0.005
Family history of melanoma - no*		
Family history of melanoma - yes	1.51 [0.80, 2.83]	0.204
Family history of non-melanoma skin cancer - no*		
Family history of non-melanoma skin cancer - yes	1.30 [0.84, 2.00]	0.238
UV exposure at work - no*		
UV exposure at work - yes	0.98 [0.53, 1.80]	0.950
Participation in other cancer screenings - no*		
Participation in other cancer screenings - yes	2.38 [1.63, 3.48]	0.000
Participation in dental check-up - no*		
Participation in dental check-up - yes	2.39 [1.69, 3.39]	0.000

adj. OR = adjusted odds ratio; CI = confidence interval

*Reference category; statistically significant differences in bold

Model fit: Omnibus test $p < 0.001$; Hosmer-Lemeshow test $p = 0.841$; $R^2 = 0.15$

We found that more men than women (55.3% vs. 44.7%) participated in workplace TBSE, with a mean age of participants of 43.3 years. By contrast, in rSCS, the mean age of participants was 69.0 years, and the majority were female (56%) (Krensel et al. 2020). Overall, pensioners showed the largest proportion of participants in rSCS (Anastasiadou et al. 2016; Grobe et al. 2014). In addition, 26.7% of the TBSE participants had not participated in rSCS before. Thus, workplace TBSE seems to have a different target group when compared to rSCS reaching out to more young people and men, mainly due to the setting and potentially by the industry sectors of the companies.

In our study, we found age to be strongly associated with the participation in rSCS, with higher participation rates at higher ages. This result is consistent with earlier findings on participation in skin examinations in Germany and the USA (Santmyre et al. 2001a; Anastasiadou et al. 2016). In contrast to the study in the USA, we did not find educational level to be associated with the participation. Our study confirmed the finding that participants of

preventive medical measurements take part in other preventive medical measurements more often (Shapiro et al. 2001b; Sieverding et al. 2010; Bertaut et al. 2018; Eichholzer et al. 2016). Both the association between rSCS participation and other cancer screening participation, as well as the association between rSCS and dental screening participation were significant. In addition, we also found risk behaviour to be associated with lower participation rates in rSCS: People with several sunburns per year and regular sunbed use were less likely to take part in rSCS. This could reflect a generally lower awareness for the risks of skin cancer.

As a possible effect of the workplace TBSE, which still needs to be verified in a controlled study, we found that the proportion of people seeking shade as UV protection as well as the number of visits at dermatologists and general practitioners increased significantly in the 12 months after the TBSE. The latter might be due to a recommendation in the TBSE to see a doctor afterwards: The level of sunbed use was already low before the TBSE and therefore did not change significantly. The participation rates (ever) in

Table 3 Risk and preventive behaviour of N=998 participants at T1 and T3 assessed by questionnaire

		T1		T3		Change in %	p
		n	% (95% CI)	n	% (95% CI)		
UV protection	Shade	597	60.3 [57.2, 63.4]	630	63.3 [60.2, 66.3]	5.53	0.022
	Long clothing	336	33.9 [31.0, 37.0]	349	35.0 [32.1, 38.1]	3.87	0.464
	Sunscreen use	781	78.9 [76.2, 81.4]	782	78.5 [75.8, 81.0]	0.13	0.878
	None	40	4.0 [2.9, 5.5]	39	3.9 [2.8, 5.3]	−2.5	0.766
Sunbed use	Never	874	92.6 [90.7, 94.2]	883	93.5 [91.8, 95.0]	1.03	0.679
	Sometimes	62	6.6 [5.1, 8.3]	55	5.8 [4.4, 7.5]	−11.29	
	Regularly	8	0.9 [0.4, 1.7]	6	0.6 [0.2, 1.4]	−25.0	
Dermatologist consultations in last 12 months	0	671	72.5 [0.70, 0.75]	50	5.4 [4.0, 7.1]	−92.55	0.000
	1–2	228	24.6 [21.9, 27.6]	847	91.6 [89.6, 93.3]	271.49	
	3–5	18	1.9 [1.2, 3.1]	23	2.5 [1.6, 3.7]	27.78	
	6–10	5	0.5 [0.2, 1.3]	2	0.2 [0.02, 0.8]	−60.0	
	> 10	3	0.3 [0.07, 0.9]	3	0.3 [0.07, 0.9]	0	
GP consultations in last 12 months	0	170	17.1 [14.8, 19.6]	172	17.3 [15.0, 19.8]	1.18	0.024
	1–2	558	56.2 [53.0, 59.3]	510	51.4 [48.2, 54.5]	−8.60	
	3–5	225	22.7 [20.1, 25.4]	262	26.4 [23.7, 29.2]	16.45	
	6–10	33	3.3 [2.3, 4.6]	37	3.7 [2.6, 5.1]	12.12	
	> 10	7	0.7 [0.2, 1.4]	12	1.2 [0.6, 2.1]	71.43	
Participation in preventive examinations at least once in lifetime* (T1)	Screening for colorectal cancer (age ≥ 50)	151	55.9 [49.8, 61.2]	–	–		–
	Cancer screening at gynaecologist (women)	389	89.8 [86.6, 92.5]	–	–		–
	Cancer screening at urologist (men)	73	73.7 [63.9, 82.1]	–	–		–
	Dental check (all)	890	92.7 [90.9, 94.3]	–	–		–
Participation in preventive examinations in last 12 months (T3)	Screening for colorectal cancer (age ≥ 50)	–	–	137	50.7 [44.6, 56.8]		–
	Cancer screening at gynaecologist (women)	–	–	377	87.1 [83.5, 90.1]		–
	Cancer screening at urologist (men)	–	–	58	58.6 [48.2, 68.4]		–
	Dental check-up (all)	–	–	891	92.8 [91.0, 94.4]		–

GP=general practitioner; T1=time point 1, before beginning of workplace total-body skin examination; T3=time point 3, 12 months after workplace total-body skin examination

*Rates calculated for persons eligible for the corresponding examination: skin cancer screening=women and men ≥35 years; colorectal cancer screening=women and men ≥55 years; cancer screening at gynaecologist=all women; cancer screening at urologist=men ≥55 years; dental check=all women and men; p value calculated by McNemar test; statistically significant differences in bold

other preventive medical examinations were high before the screening. Nevertheless, participation rates within twelve months after TBSE were close to participation rates during the entire lifetime. This suggests that TBSE participants were reminded of other screenings and took part in them shortly after the TBSE even though not all of them are offered annually. All the significant differences in preventive health behaviour between T1 and T3 lead to the hypothesis to be confirmed that health education during the TBSE has impacted the preventive and risk behaviour of participants positively.

In addition to the positive effect on preventive health behaviour, it is possible that TBSE has a spillover effect and promotes rSCS. About two thirds of TBSE participants recommended skin cancer screenings in the form of rSCS to others and one third of them were confident that this recommendation was followed. However, these recommendations are associated with female gender, older age, and lower school education. Interestingly, lower education is a risk factor for non-participation in preventive measures (Damiani et al. 2012; Walsh et al. 2011; Seidel et al. 2009) and the workplace TBSE might be an effective opportunity to inform this target group about skin cancer screenings.

Table 4 Factors associated with the recommendation of routine skin cancer screenings by workplace total-body skin examination participants to others. Results of binary logistic regression analysis ($n = 824$)

Variable categories	adj. OR (95% CI)	<i>p</i> value
Sex - male*		
Sex - female	1.62 [1.17, 2.24]	0.003
Age (continuous variable in years)	1.02 [1.01, 1.04]	0.010
School education - secondary school*		
School education - high School	0.60 [0.44, 0.83]	0.002
Sunburn - never*		
Sunburn - once a year	0.92 [0.67, 1.28]	0.631
Sunburn - several times per year	0.75 [0.48, 1.19]	0.221
Sunbed use - never*		
Sunbed use - sometimes	1.03 [0.58, 1.93]	0.930
Sunbed use - regularly	3.44 [0.40, 29.30]	0.259
Dermatologist consultations in last 12 months (T3) - 0*		
Dermatologist consultations in last 12 months (T3) - 1–2	1.15 [0.80, 1.64]	0.450
Dermatologist consultations in last 12 months (T3) - 3–5	1.85 [0.58, 5.86]	0.298
Dermatologist consultations in last 12 months (T3) - 6–10	0.50 [0.07, 3.80]	0.500
Dermatologist consultations in last 12 months (T3) - > 10	0.00 [0.00]	0.999
UV protection - shade (T3) - no*		
UV protection - shade (T3) - yes	1.02 [0.74, 1.41]	0.887
UV protection - long clothing (T3) - no*		
UV protection - long clothing (T3) - yes	1.24 [0.89, 1.72]	0.208
UV protection - sunscreen use (T3) - no*		
UV protection - sunscreen use (T3) - yes	1.44 [0.99, 2.09]	0.058
Received suspected diagnosis in TBSE - no*		
Received suspected diagnosis in TBSE - yes	1.13 [0.70, 1.83]	0.610

adj. OR=adjusted odds ratio; CI=confidence interval; T3=time point 3, 12 months after the workplace total-body skin examination; TBSE=total-body skin examination

*Reference category; statistically significant differences in bold

Model fit: Omnibus test $p = 0.001$; Hosmer-Lemeshow test $p = 0.884$; $R^2 = 0.064$

Some limitations need to be considered when evaluating the results of this study. First, multiplicity may occur due to the number of tests performed in this study. Second, we cannot rule out selection bias for participation in this study as we do not have information on non-participants. Since only about one third of TBSE participants agreed to take part in this voluntary study, the selection effect could be relevant.

Our study covers a wide range of employees but referring to findings on other preventive measures it is reasonable that differences in participation due to socioeconomic factors also occur in workplace examinations (Starker and Saß 2013; Damiani et al. 2012; Doubeni et al. 2009). However, the relatively high share (40.8%) of participants with lower educational level in the TBSE indicates that these measures also reach out to lower educational groups. One reason could be the direct offer of appointments to employees without the need to inform themselves actively or to arrange a long-term appointment. Third, in the analyses of rSCS participation and preventive behaviour, the direction of causality cannot

be derived from our study. On the one hand, it is possible that participants of the rSCS were informed about preventive behaviour during the screening and began to apply these strategies after rSCS. On the other hand, it is also possible that people who use preventive measures are more often informed about the screening. Thus, we cannot conclude if participation in rSCS leads to a change of preventive behaviour but can only conclude behaviour change from the detected differences after the TBSE.

Conclusion

TBSE in the workplace are a useful complementary approach to rSCS, as they can reach a different target population. In addition, they can be used to inform participants about the existence and the benefit of the rSCS programmes which can lead to spillover effects for peers. They also serve as a further source of health information and information on prevention and risk of behaviour.

Appendix

Fig. 1 Participants' communication about routine skin cancer screening covered by statutory health insurance in peer groups 12 months after the workplace total-body skin examination (T3)

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Authors' contributions All authors whose names appear on the submission 1) made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work; 2) drafted the work or revised it critically for important intellectual content; 3) approved the version to be published; 4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The approval of the Ethics Committee of the Hamburg Medical Association was obtained (PV5123).

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