

Frequency of bullying at work, physiological response, and mental health[☆]

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Received 11 September 2009; received in revised form 27 April 2010; accepted 11 May 2010

Abstract

Objective: The present study aimed to elucidate the relationship between bullying at work and cortisol secretion. Of particular interest was to examine whether frequently and occasionally bullied persons differed from nonbullied persons. **Methods:** The study included 1944 employees (1413 women and 531 men) from 55 workplaces in Denmark (16 private and 39 public workplaces). During a work day three saliva samples were collected at awakening, +30 min later, and at 20:00 hours, and analyzed for cortisol concentrations. Mental health was assessed using items on somatic, cognitive, stress, and depressive mood. **Results:** Of the 1944 employees, 1.1% was frequently bullied and 7.2% occasionally bullied. Frequently bullied persons reported poorer mental health and had a 24.8% lower salivary cortisol concentration compared with the nonbullied reference group. Occasionally bullied persons had a poorer self-reported mental health, but their

cortisol concentrations did not deviate from the group of nonbullied persons. The associations remained significant even after controlling for age, gender, exact time of sampling, mental health, and duration of bullying. Bullying occurred at 78% of the workplaces (43 workplaces); frequent bullying occurred at 21% of the workplaces (40%). **Conclusion:** Frequent bullying was associated with lower salivary cortisol concentrations. No such association was observed for occasional bullying. Whether the generally lower secretion of cortisol among the frequently bullied persons indicate an altered physiological status remains to be evaluated in future studies. Yet, the physiological response seems to underscore the possibility that bullying indeed may have measurable physiological consequences. Hence, the physiological response supports the mental symptoms found among the frequently bullied. © 2011 Elsevier Inc. All rights reserved.

Keywords: Bullying; Mental health; Stress symptoms; Depressive symptoms; Cortisol level

Introduction

Stressful and poorly organized work environments as well as deficiencies in leadership may facilitate work-related bullying either directly or by creating a work climate in

which bullying can flourish [1–5]. Indeed, the phenomenon addressed as workplace “mobbing,” “bullying,” or “emotional abuse,” etc., has been the object of many studies. In Denmark, it has been estimated that 8.3% of the working population between 20 and 59 years of age has been subjected to bullying within the past year [6]. Of these, 1.6% reported frequent bullying, that is, weekly or daily. Similar results were observed in a previous study among 2539 Norwegian employees where 2% reported severe workplace bullying [7].

The most studied health outcomes of bullying are psychological symptoms and emotional reactions such as depression, burnout, anxiety, and aggression [8–12]. But also psychosomatic and musculoskeletal health complaints have

Abbreviation: CAR, cortisol awakening response; Decline, decline in cortisol from the second morning sample to the evening sample.

[☆] The Working Environment Research Foundation, Denmark, supported the study.

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often been in focus [13–17]. According to transactional stress models, the nature and severity of emotional reactions following exposure to bullying may be a function of a dynamic interplay between event characteristics and individual appraisal- and coping processes [18–20]. Definitions of bullying at work commonly entail descriptions that emphasize *prolonged exposure to interpersonal acts of a negative nature*, with which the target is *unable to cope*. These negative acts may be both person related and work related. Together, these factors are likely to make up a highly stressful situation characterized by lack of control. Attributions of control and predictability are salient features of the individual's appraisal processes [19,21]. While the link between cognitive processes and physiology is emphasized in transactional models such as the cognitive activation theory of stress and the allostasis model, it is clear that the physiological consequences of bullying have been insufficiently examined and understood [22,23].

Theoretically, stress reactions may affect health either by a direct biological, prolonged physiological activation and lack of restitution, or by affecting health through lifestyle and health behaviors [24]. However, to this date, only two studies have addressed the physiological responses to workplace bullying with biological measurements among occupationally active targets [25,26]. Kudielka and Kern [26] found no significant differences in terms of both morning cortisol increase and cortisol day profile between the work day and the day off among 12 women and four men (aged 45 years, range 33–60 years). Nonetheless, the difference between the peak cortisol level in the morning and the lowest level in the evening showed a trend toward a lesser decrease at the work day ($P=.10$) among people bullied at work [26]. Similarly, Hansen et al. [25] observed signs of an altered hypothalamic-pituitary-adrenal axis activity manifested as a lower excreted amount of salivary cortisol in the morning. The stress response, which occurs when homeostasis is threatened or perceived to be threatened, is mediated by the stress system. Cortisol is a natural energy-releasing hormone with a distinct diurnal rhythm being highest in the morning and decreasing to the lowest in the evening. The regulation of cortisol can be disturbed in various ways such as high cortisol over a longer period, a flat diurnal cortisol curve (i.e., low morning cortisol or high evening cortisol), or insufficiently secreted cortisol [27]. Hence the lower cortisol in the morning among bullied employees [25] may indicate a lower energy level in the morning.

While previous studies were interesting and potentially may explain how bullying get “under the skin,” it is equally clear that the design of the studies and the methods used have limitations. Accordingly, the results needed to be replicated in other populations and with stronger study designs in order to test their validity. A limitation of our previous study was that the definition of bullying did not include the frequency or duration of bullying. Severity and duration of bullying are considered important, although controversies exist about how to incorporate them in the definition of bullying [4].

Leymann [4] suggested exposure to at least one negative act at least weekly for 6 months. Other researchers [28,29] have argued that there may be incidents so severe and long lasting that they do not necessarily have to be repeated frequently during longer periods of time [30]. Yet, many researchers agree that “at least weekly over a longer period of time” should be included in the definition of bullying. When using this restriction the occurrence of bullying is often estimated to be between 1% and 2% [31]. However, bullying is not an either–or phenomenon but rather a gradually evolving and escalating process [32]. And it has been found that even being bullied occasionally may have an impact on the health and well-being [33].

Thus, we wanted to investigate whether there is a difference in cortisol profiles and health symptoms between frequently (daily or weekly) and occasionally (monthly or now and then) bullied occupationally active persons. The hypothesis being that being bullied for a long time as well as being bullied frequently is related to lower levels of salivary cortisol and health problems.

Methods

Participants

Participation was voluntary and all participants gave their written consent to the study. The study protocol was approved by the local ethics committee (KF 01 302955). All participants were respondents to a psychosocial work environment and health survey conducted at 60 workplaces in Denmark in 2006. In total, 2255 women and 1099 men ($N=3363$) completed the survey (i.e., 46% response rate).

Three questions were used to classify bullied respondents, witnesses to bullying, and perpetrators. To calibrate the respondents, a definition of bullying was listed ahead of the questions: “Bullying takes place when employees are exposed to negative or offensive acts repeatedly over a longer period of time, which it is difficult to defend oneself against.” The three questions read: “Have you been subjected to bullying at work within the past 6 months?” “Have you witnessed bullying at work within the past 6 months?” “Have you yourself bullied someone or participated in bullying someone at work within the past 6 months?” These items were responded to on a five-step scale: 1=never, 2=now and then, 3=monthly, 4=weekly, 5=daily. Respondents were excluded from the target groups if answering two or more on having bullied someone. One item measured duration of bullying, “For how long time have you been bullied?” and was responded to on a five-point scale: <1 month, 1–6 months, 7–12 months, 1–2 years, and >3 years.

Of the whole sample, 75.5% [1807 women and 734 men ($n=2541$)] gave saliva samples (i.e., 34.5% response rate) for determination of cortisol concentrations. Only respondents who gave saliva samples and had answered the questions about bullying were included ($n=1944$). Persons who reported being witnesses ($n=406$) or perpetrators ($n=143$)

were not included. Hence, the final study sample entailed 55 of the 60 workplaces and 1944 respondents. In line with our hypothesis, three groups were identified. The *reference group* ($n=1783$; 1299 women and 484 men) comprised individuals who did not acknowledge being bullied, having witnessed bullying, or having bullied others. The second group ($n=139$; 92 women and 47 men) consisted of respondents who reported being bullied now and then or monthly (*occasionally bullied*). The third group ($n=22$; 18 women and four men) consisted of respondents who reported being bullied weekly or daily (*frequently bullied*).

Health measures

A questionnaire was mailed to the respondents as a paper-and-pencil version. Each participant was also given the opportunity to fill in the questionnaire electronically which approximately 3% of the respondents did. In addition, a hotline for any queries in connection with filling in the questionnaire and sampling of saliva was established.

The questionnaire included four questions about *Somatic symptoms* the past 4 weeks from the Stress Profile questionnaire developed by Setterlind and Larsson [34]: “How often have you had stomach ache?” “How often have you had palpitations?” “How often have you had tension in various muscles?” “How often have you had a headache?” Each item was rated on a five-point scale ranging from 1 (*never*) to 5 (*very often*) (Cronbach’s $\alpha=0.70$). A high score indicates more symptoms.

Cognitive symptoms the past 4 weeks were measured by four items also from the stress profile questionnaire: “How often have you had problems concentrating?” “How often have you found it difficult to think clearly?” “How often have you had difficulties remembering?” “How often have you found it difficult to think clearly?” Each item was rated on a five-point scale ranging from 1 (*never*) to 5 (*very often*) (Cronbach’s $\alpha=0.77$). A high score indicates more symptoms.

Stress symptoms the past 4 weeks were measured by four items derived from the second version of the Copenhagen Psychosocial Questionnaire [35]: “How often have you had problems relaxing?” “How often have you been irritable?” “How often have you been tense?” “How often have you been stressed?” These items were responded to on a five-point scale ranging from 1 (*never*) to 5 (*very often*) (Cronbach’s $\alpha=0.85$). A high score indicates more symptoms.

Depressive symptoms were measured by 12 items from the Major Depression Inventory [36]: “Have you felt in low spirits or sad?” “Have you lost interest in your daily activities?” “Have you felt lacking in energy and strength?” “Have you felt less self-confident?” “Have you had a bad conscience or feelings of guilt?” “Have you felt that life wasn’t worth living?” “Have you had difficulty concentrating, e.g., when reading the newspaper or watching television?” “Have you felt very restless?” “Have you felt subdued?” “Have you had trouble sleeping at night?” “Have

you suffered from reduced appetite?” “Have you suffered from increased appetite?” All items were responded to on a six-point scale: 1 (*Not at all*) to 6 (*All the time*) (Cronbach’s $\alpha=0.82$). A high score indicates more symptoms.

Salivary cortisol and collection of saliva samples

The saliva samples were collected during a workday. They were collected in Salivette cotton tubes at awakening, 30 min after awakening, and at approx. 20:00 hours. A written instruction emphasized that swabs should be kept in the mouth until thoroughly hydrated and to carefully fill in the exact time of sampling when collecting each saliva sample [37]. Samples were stored in a refrigerator until they were returned by mail. The samples were stored at -20°C and analyzed within 6 months. Approx. 9% of the samples contained too little amount of saliva to be analyzed for cortisol (dry samples).

The cortisol variables that were analyzed in the present study were (i) the cortisol concentration (nmol/l) at awakening, +30 min after awakening, and in the evening at approx. 20:00 hours. Derived variables were cortisol awakening response (CAR) and decline during the day:

$$\text{CAR} = [\text{concentration of cortisol at } +30 \text{ min}] \\ - [\text{concentration of cortisol at awakening}].$$

$$\text{Decline} = [\text{concentration of cortisol at } +30 \text{ min}] \\ - [\text{concentration of cortisol in the evening}].$$

Method performance of measurement of cortisol in saliva

Determination of cortisol in saliva was carried out with a competitive radioimmunoassay (Spectria Cortisol Coated Tube RIA, purchased from Orion Diagnostica, Espoo, Finland) designed for quantitative in vitro measurement of cortisol in serum, plasma, urine, and saliva, according to the manufacturer’s specifications. The sample volume was 150 μl , the range of the standard solutions prepared was 1.0–100.0 nmol/l, and the incubation time was 30 min at 37°C . The specifications given by the manufacturer were a sensitivity of twice the standard deviation of the zero-binding value in saliva (0.8 nmol/l), a bias of 110% (103–115%), an intra-assay variation of 5.4%, and an interassay variation of 7.3%. The cross-reactivity to cortisone was $<0.2\%$. A 1470 Wizard gamma counter (Wallac, Turku, Finland) was used for measurement of radioactivity. A method evaluation of certified reference material in water performed by our laboratory showed no bias of the method, with recovery being 97% (95% CI: 94.0–100.9). Limit of detection (LOD) was 1.59 nmol/l. Between-run coefficients of variation (CVs) were 19% at 11.5 nmol/l and 16% at 49.2 nmol/l [38]. Eight measurements were excluded from the results as outliers (above 100 nmol/l).

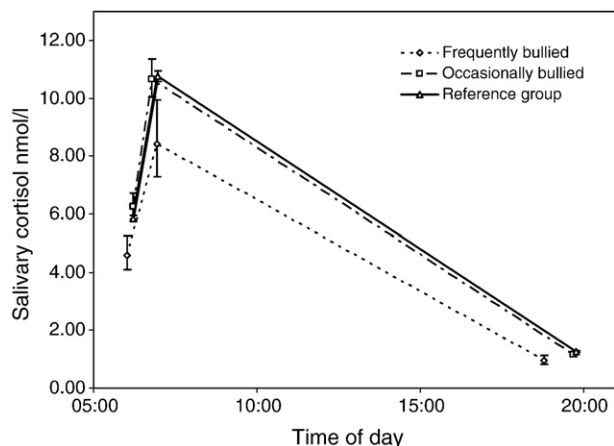


Fig. 1. Mean concentrations of cortisol in saliva during a working day among frequently and occasionally bullied respondents and among nonbullied men and women. Mean concentrations (\pm S.E.M.) of cortisol measured in saliva collected at awakening, 30 min after awakening, and at 20:00 hours on a working day.

To show equivalence between different runs, natural saliva samples (5.9 and 18.5 nmol/l) were used as control materials and analyzed together with the samples. Westgard control charts were used to document that the analytical method remained under analytical and statistical control—in other words, that the trueness and the precision of the analytical methods remained stable [39]. The performance of the methods has been further validated by participation in interlaboratory comparison schemes [38,40].

Statistics

A general linear model procedure was used to test for differences in somatic, cognitive, stress, and depressive symptoms; the concentration of cortisol at the three time points (at awakening, +30 min after awakening, and at approx. 20:00 hours); CAR; and the decline between targets

and the reference group. *P* values below .05 were considered statistically significant. The models were adjusted for gender and age. Pearson's product-moment correlations as well as Spearman's rho were computed to test the associations between somatic, cognitive, stress, and depressive symptoms and salivary cortisol. For the final models on mental health, symptoms were expressed as deviation from reference group in standardized deviation units (*Z* scores). The model was adjusted for gender and age. The SPSS statistical software version 17.0 was used for these analyses.

A multilevel regression analysis using the Proc mixed procedure in SAS version 9.1 was established to analyze the associations between frequent and occasional bullying and salivary cortisol. Due to nonnormal (skewed) distributions and increasing variances, concentrations of cortisol were analyzed on a logarithmic scale. The employees were nested to workplace and included in the random statement. A total of 5355 saliva samples were included in the statistical analysis. The initial models included *bullied* [three levels (reference, occasionally bullied, and frequently bullied) or five levels (never, now and then, monthly, weekly, and daily)], *time of sampling* (three levels), and the interaction terms *Bullied* \times *Time of sampling* as categorical independent variables. The effect of the exact sampling time was evaluated by including the variable *exact time of sampling* (linear and squared) as continuous independent variables. The initial model was adjusted for age and gender. The final model was adjusted for mental health and duration of bullying. Before presenting the data from the log-transformed scores in Fig. 1, data were converted back into the original scale after testing.

Results

Mean age and scores on somatic, cognitive, stress, and depressive symptoms (median and 25% and 75% percentiles) among the frequently (1.1%) and occasionally bullied

Table 1

Age and scores on somatic, cognitive, and stress symptoms among bullied and nonbullied employees in 55 companies in Denmark [mean (S.E.)]

		Frequently bullied		Occasionally bullied		Reference group	
		Women	Men	Women	Men	Women	Men
	<i>n</i>	18	4	92	47	1303	480
	Age	49.7	48.0	45.5	48.6	45.3	46.7
Somatic symptoms (1–5)	Median	1.72	1.25	1.25	1.25	0.94	0.63
	25% percentile	0.31	0.47	0.94	0.63	0.31	0.31
	75% percentile	2.81	1.88	1.88	2.19	1.56	0.94
Cognitive symptoms (1–5)	Median	1.04	1.46	1.25	1.25	0.83	0.83
	25% percentile	0.42	0.63	0.63	0.83	0.42	0.00
	75% percentile	2.08	1.88	2.08	2.08	1.25	1.25
Stress symptoms (1–5)	Median	2.50	2.03	1.88	2.19	1.25	1.25
	25% percentile	0.94	1.25	1.25	1.25	0.63	0.63
	75% percentile	3.44	2.19	2.50	2.81	1.88	1.88
Depressive symptoms (1–24)	Median	16	15	10	11	6	4
	25% percentile	5	6	6	6	3	2
	75% percentile	23	24	19	17	10	8

Table 2

Raw data of cortisol in saliva from frequently and occasionally bullied and a nonbullied reference group

		Frequently bullied (<i>n</i> =22)		Occasionally bullied (<i>n</i> =139)		Reference group (<i>n</i> =1783)	
		Time of sampling	Cortisol (nmol/l)	Time of sampling	Cortisol (nmol/l)	Time of sampling	Cortisol (nmol/l)
At awakening	Median	5:57	4.85	6:09	6.50	6:09	6.50
	25% percentile	5:20	3.70	5:30	4.45	5:40	4.10
	75% percentile	6:35	6.50	6:45	9.85	6:45	9.50
+30 min	Median	6:30	8.90	6:45	11.50	6:45	11.60
	25% percentile	6:05	6.40	6:00	7.50	6:15	7.70
	75% percentile	7:10	13.10	7:15	17.10	7:20	16.60
Evening	Median	20:00	1.00	20:00	1.10	20:00	1.20
	25% percentile	20:00	.60	20:00	.80	20:00	.80
	75% percentile	20:05	1.80	20:30	1.80	20:30	1.90
CAR	Median		4.15		4.15		5.00
	25% percentile		.40		.40		1.20
	75% percentile		6.90		6.90		9.50
Decline	Median		7.70		10.50		10.30
	25% percentile		5.40		6.50		6.30
	75% percentile		12.40		15.60		15.20

(7.2%) and the reference group are presented in Table 1. The frequently bullied scored higher on depressive symptoms compared to the reference group among both men and women [women/men: 16 (5–23)/15 (6–24) vs. 6 (3–10)/4 (2–8)]. Frequently bullied women scored highest on somatic and stress symptoms compared to the reference group and the occasionally bullied. Bullying occurred at 78% of the workplaces in the study (43 workplaces), and frequent bullying occurred at 21 of the workplaces (40%).

Table 2 presents the median and 25% and 75% percentiles of the raw data on concentration of cortisol in saliva and the exact time of sampling at awakening, +30 min after awakening, and at approximately 20:00 hours among the frequently and occasionally bullied and a reference group. Frequently bullied had lower salivary cortisol at awakening, +30 min after awakening, and in the evening. When testing for differences in the derived

cortisol variables, that is, the CAR and decline during the day, no statistically significant differences were observed (Table 3).

Significant correlation between somatic, cognitive, stress, and depressive symptoms was observed (Table 3). Somatic, cognitive, and stress symptoms were highly inter-correlated ($r=0.54$ to $r=0.74$), whereas no correlations were observed between these symptoms and cortisol measures.

Somatic, stress, and depressive symptoms showed a gradient where the highest scores were observed among the frequently bullied followed in decreasing order by the group of occasionally bullied and the nonbullied reference group. No difference was observed between the frequently and occasionally bullied with regard to cognitive symptoms (Table 4). Compared to men, women reported more somatic ($P<.001$), cognitive ($P=.008$), and depressive symptoms ($P=.008$), but not more stress symptoms ($P=.382$). The

Table 3

Correlation between somatic, cognitive, stress, depressive symptoms, and salivary cortisol at awakening, + 30 min after awakening, and in the evening

		Symptoms				Salivary cortisol		
		Somatic	Cognitive	Stress	Depressive	At awakening	+30 min	Evening
Bullied	Pearson's <i>r</i>	.170	.122	.202	.205	.001	–.027	–.037
	<i>P</i> value	.000	.000	.000	.000	.968	.259	.117
	<i>n</i>	1937	1934	1937	1909	1717	1773	1837
Somatic symptoms	Pearson's <i>r</i>		.537	.663	.616	–.037	.045	.000
	<i>P</i> value		.000	.000	.000	.128	.057	.998
	<i>n</i>		1975	1978	1948	1742	1800	1862
Cognitive symptoms	Pearson's <i>r</i>			.663	.691	–.011	.036	–.028
	<i>P</i> value			.000	.000	.647	.127	.226
	<i>n</i>			1975	1946	1738	1797	1858
Stress symptoms	Pearson's <i>r</i>				.749	–.021	.027	–.031
	<i>P</i> value				.000	.385	.258	.186
	<i>n</i>				1949	1742	1801	1862
Depressive symptoms	Pearson's <i>r</i>					–.035	.026	–.022
	<i>P</i> value					.147	.278	.349
	<i>n</i>					1716	1774	1836

Table 4

Difference ($Z-\Delta$) from reference group for frequently and occasionally bullied employees on mental health

	Occasionally bullied			Frequently bullied		
	$Z-\Delta$ score	95% CI	P value	$Z-\Delta$ score	95% CI	P value
Somatic symptoms	0.61	[0.44–0.78]	.000	0.83	[0.42–1.24]	.000
Cognitive symptoms	0.47	[0.30–0.64]	.000	0.49	[0.07–0.91]	.022
Stress symptoms	0.72	[0.55–0.89]	.000	0.97	[0.56–1.38]	.000
Depressive symptoms	0.75	[0.58–0.92]	.000	0.96	[0.55–1.38]	.000

Adjusted for gender and age; $Z-\Delta$ =difference from reference group in standardized deviation units (Z scores).

reporting of mental health symptoms decreased significantly with age.

Salivary cortisol

A variance component analysis of all samples collected showed that the group of frequently bullied in general had a 24.8% [factor: 0.752 (CI: 0.62–0.91)] (Table 5, Fig. 1) lower concentration of cortisol in the saliva compared to the occasionally bullied and the reference group. The mean concentration of salivary cortisol is given for a 30-year-old man from the reference group at awakening. To calculate the concentration 30 min after awakening, the median concentration must be multiplied with the specific factor for 30 min after awakening (1.788). Corresponding formulas can be extracted for the other variables in the table. No difference was observed between the occasionally bullied and the reference group. There was no statistically significant interaction between time of sampling and being bullied. Adjusting for the subjective indicators of mental health did not change the difference between the frequently bullied and the reference group as

well as the occasionally bullied. Furthermore, a test among the targets showed that the duration of bullying had no significant association with cortisol and did not change the difference between the frequently and occasionally bullied (data not shown).

Discussion

The present study examined the association between work place bullying and salivary cortisol pattern. The results showed that the frequently bullied, irrespective of gender, generally reported more mental health symptoms and had lower salivary cortisol when compared to the nonbullied reference group. In contrast, the occasionally bullied reported poorer mental health when compared to the nonbullied reference group but did not deviate from them as regards the salivary cortisol concentrations.

The generally lower cortisol concentration among the frequently bullied was in line with the previously mentioned pilot study [26] and with our previous study [25]. However, we now distinguished between frequently and occasionally bullied. We found an association between low salivary cortisol among frequently bullied and not among occasionally bullied indicating a kind of dose–response relationship which we could not extract from previous studies. Yet the present data suggest that being bullied frequently is associated with a generally lower cortisol secretion but not a different diurnal profile. Indeed, there was no interaction between time of day and bullying status and there were no differences between the groups as regards the derived measures, that is, the CAR and decline during the day, both of which have been used widely in psycho-physiological research [41,42]. Workplace bullying has been shown to be strongly associated with sleep disturbances [33,43]. Furthermore, loss of sleep has been related to inhibition of the stress system [44]. Hence, the low cortisol among the bullied may be due to poor sleep [45].

A lower concentration of cortisol has previously been observed in individuals with posttraumatic stress disorder compared with controls, with the largest difference between 2000 and 0500 hours [46]. In addition, relatively lower cortisol concentrations have also been observed among healthy individuals living under conditions of chronic stress and among patients with several bodily disorders [47,48]. According to McEwen [24], a failure to activate the

Table 5

Cortisol in saliva among frequently bullied, occasionally bullied, and nonbullied men and women

	Median of exact time of sampling	Nanomoles of cortisol per liter of saliva	Factor	P value
Cortisol in saliva of a 30-year-old man from the reference group at awakening	06:13	4.792		
Frequently bullied			0.752	.002
Occasionally bullied			1.003	.930
+30 min	06:45		1.788	<.0001
Evening	20:00		0.746	<.0001
Age (per 10 years of age)			1.022	.033
Gender			0.970	.182
Somatic symptoms			1.000	.774
Cognitive symptoms			1.001	.514
Stress symptoms			1.000	.802
Depressive symptoms			0.997	.246

The statistical model was performed on logarithmically transformed data adjusted for gender, age, exact time of sampling, and mental health.

physiological stress response in a stressful situation will mean an extra burden on the health as the physiological imbalance will be maintained and there is a risk of cascade effects when other physiological systems need to compensate for the failure [24]. Speculatively, experiencing bullying on a daily or weekly basis will adjust the cortisol secretion downwards and possibly be a sign of emerging poor health. On the other hand, it should be recognized that it cannot be excluded that the current group of frequently bullied had lower cortisol concentrations to begin with. That question remains to be tested in our follow-up study which is designed to allow identification of newly bullied persons.

As regards the group of occasionally bullied, the data seem to suggest that their bodily response is normal even though they show signs of poor mental health. However, poor mental health seems, as expected, to be less pronounced among the occasionally bullied compared with the frequently bullied. However, even though we find the strongest effects for the frequently bullied it cannot be ignored that bullying seems to have an impact on the mental health of the occasionally bullied targets.

When addressing the duration of bullying (1 month up to 2 years), we did not find any associations between reported duration and salivary cortisol secretion either among the occasionally bullied or among the frequently bullied respondents. This finding seems contradictory to Leymann [4] who suggested that duration of least 6 months should be included in the definition of bullying.

As expected, bullying at work was associated with self-reported poor mental health which is in agreement with several other studies [25,49,50]. The bullied respondents were also more likely to report depressive symptoms as measured by the Major Depression Inventory compared to a reference group. A previous study found no gender difference in major depression rate, whereas a gender difference of men to women of 1:2 was found when including minor depression [51]. We found no gender differences with regard to health effects in our study group, which was in contrast to previous findings. The duration of bullying did not influence the results.

Strengths and limitations

The low response rate in combination with a nonrandom allocation of participants questions the generalization of the results for the study. Since the allocation of participants was conducted group wise, by having workplaces actively volunteer to participate, one could perhaps expect positive selection and a higher than normal prevalence of bullying in the present study sample. However, the prevalence of bullying is comparable to what was previously found in a representative population study in Denmark, in which 6.7% reported occasional bullying and 1.6% frequent bullying [6]. Hence, it seems unlikely that our study sample should represent workplaces with unusually heavy or light bullying problems. Indeed, the fact that the bullied persons were well

spread out across the workplaces as opposed to being clustered to a few workplaces seems to support such an interpretation. Compared to measures of bullying behavior, the reliability of using a single item to measure bullying is low. However, a study comparing different measures of workplace bullying has found that the correlation between bullying behavior (measured by several negative acts) and a single item of self-labelled bullying including a definition is high [31]. A single item may underestimate the number of bullied respondents [52]. However, bullying may be measured in different ways that are not exactly comparable. We wanted to compare the results from our previous survey [25] based on a sample of Swedish employees with the findings in the present Danish workplace study. Thus, we decided to use the item that was comparable—the self-labeled question in the questionnaire, since this was used in both studies. The Swedish study did not measure negative acts in general.

The fact that there were markedly more women among the frequently bullied compared to the occasionally bullied and the reference group raises suspicions of a possible gender bias. However, previous studies have shown that normal healthy women tend to have higher cortisol concentrations than normal healthy men [38]. Thus, the gender imbalance is not likely to account for the lower concentrations of salivary cortisol that is observed among the frequently bullied. On the contrary, it seems more likely that a potential gender bias will serve to minimize the differences, which could lead to an underestimation of the effect.

Another potential pitfall is response bias. Since the questions asked in relation to bullying could be perceived as rather sensitive, there is reason to suspect that some respondents might fail to admit to being a target of bullying. Obviously, to admit to being bullied is in a sense an admittance to weakness and inadequate coping, which may be difficult for many people [53] and may lead to missing data [54]. However, a previous study showed questionnaires to be the method with the highest response rate to sensitive questions compared to both telephone and person-to-person interviews [55]. In addition, it seems likely that bias due to failure to admit to being bullied would lead to an underestimation of the true associations since the targets would end up in the reference group and hence minimize the contrast between groups. Despite the difficulties of identifying bullied people, it is clear that the present study represents a novel approach to studying the physiology of bullied people. The large sample size and the fact that the study group consisted of occupationally active volunteers are also strong points as many other studies have been smaller and not concerning occupationally active persons. In addition, this large-scale approach allowed us to identify a small but sufficiently large group. Another strong point compared to other studies is that we used a fairly fine-grained definition of bullying that included both the frequency and duration of bullying. This allowed us to explore whether the frequency and/or duration of bullying or both is vital to the physiological functioning.

Conclusion

The most important findings were that frequent bullying is associated with lower salivary cortisol. The association remained significant even after controlling for age, gender, exact time of sampling, mental health, and duration of bullying. No such association was observed for occasional bullying. In line with previous longitudinal studies, poorer self-reported mental health was more prone among the bullied respondents irrespective of frequency and duration. Hence, the physiological response supports the self-reported mental symptoms among the frequently bullied.

Acknowledgments

Elisabeth Naima Mikkelsen and Louise Bang Olesen are acknowledged for participating in the collecting of the data. Anne Abildtrup, Dorrit Meincke, Inge Christiansen, and Ulla Tegner are acknowledged for skilled technical assistance.

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