

# Occupational risk factors for ill health in Gulf veterans of the United Kingdom

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## Abstract

**Objectives**—To study the association between occupational factors specific to the Armed Forces (rank, functional roles, Service, regular or reservist status and deployment factors) and symptomatic health problems in Gulf veterans, after sociodemographic and lifestyle factors have been accounted for.

**Design**—A postal cross sectional survey of randomly selected UK Gulf veterans was conducted six to seven years after the Gulf conflict. Physical ill health was measured using the Fatigue Questionnaire and a measure of the Centers for Disease Control and Prevention (CDC) multi-symptom syndrome. Psychological ill health was measured using the General Health Questionnaire and a post-traumatic stress measure.

**Setting**—Population of servicemen who were serving in the UK Armed Forces during the Gulf conflict between 1 September 1990 and 30 June 1991.

**Participants**—3297 Gulf veterans.

**Main results**—In multivariate logistic regression, there was an inverse relation between higher rank and psychological and physical ill health (test of trend: General Health Questionnaire,  $p=0.004$ ; post-traumatic stress,  $p=0.002$ ; fatigue,  $p=0.015$ ; CDC case,  $p=0.002$ ). Having left the Armed Forces was associated with a two to three times increase in reporting ill health. Of the deployment factors, there was a weak association between being deployed as an individual reinforcement in a combat role and post-traumatic stress but there was no association between receiving pre-deployment training or post-deployment leave and ill health. Marital status and smoking were associated with psychological and physical ill health.

**Conclusions**—Rank was the main occupational factor associated with both psychological and physical ill health in Gulf veterans. This may parallel the associations between socioeconomic status and morbidity in civilian populations. Ill health seems to be greater in those who return to civilian life. Sociodemographic factors also seem to be important in ill health in Gulf veterans.

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There is now good evidence from population-based studies that veterans of the Gulf conflict

report more health problems than military personnel not deployed to the Gulf.<sup>1-3</sup> The nature of these health problems are still not clear, but symptoms include fatigue, headaches, poor concentration and joint pains.<sup>1-3</sup> Aetiological evidence for specific exposures in the Gulf such as suspected chemical weapons, organophosphate pesticides, immunisations, pyridostigmine bromide, oil well fires and depleted uranium has been inconsistent,<sup>4</sup> probably reflecting serious measurement biases.

Little attention has been given to occupational factors specific to military populations, such as trade, Service, rank and reserve duty that may be proxy markers for ill health in Gulf veterans. In the United Kingdom, Army personnel are grouped into three main functional roles, within which a variety of trades are performed; Combat Arm, such as the Infantry and the Royal Armoured Corps, where personnel are more likely to be involved in combat; Combat Support Arm, such as the Royal Engineers; and Combat Services Support Arm, such as the Royal Army Medical Corps. Roles in the Royal Navy or Royal Air Force are not directly comparable as entire ships and airfields are at risk of attack. Army personnel may have been in closer geographical proximity to some of the environmental exposures implicated in Gulf related ill health than the Royal Navy or Royal Air Force, such as pesticides and oil well fires, although there is no published evidence for this and the Royal Air Force also had extensive ground bases. It is also possible that servicemen from lower ranks had different experiences to those of higher ranks who often have greater organisational responsibilities. Reserve duty has been suggested as significant.<sup>2 5 6</sup>

Since the first world war, preparing personnel for conflict is integral to military training. Personnel are encouraged to identify with their Units and are trained in helping their colleagues to normalise acute stress reactions.<sup>7</sup> There is much speculation that being deployed as an individual reinforcement to a different unit, not receiving pre-deployment training and lack of post-deployment leave may be associated with symptomatic distress in Gulf veterans. These factors are potential targets for intervention but have not been systematically studied.

Little attempt has been made to apply risk factors for ill health in civilian populations to military populations. Sociodemographic risk patterns of illnesses, such as age, education, socioeconomic status, marital status and lifestyle factors such as smoking and alcohol

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intake, may have an independent role in ill health in Gulf veterans. One study reported that older, divorced and enlisted US Gulf veterans were more likely to report physical symptoms.<sup>1</sup> It is not straightforward to use a serviceman's trade to classify his socioeconomic status because within a trade there is a hierarchy of rank and certain trades are unique to the military.

The main aim of this study is to examine whether certain military and deployment factors are associated with increased reporting of ill health in Gulf veterans, taking into account potential sociodemographic confounders.

## Methods

### DESIGN, POPULATION AND SAMPLE

A cross sectional postal survey was conducted on a randomly selected sample of UK Armed Forces servicemen who were deployed to the Gulf between 1 September 1990 and 30 June 1991 (n=3905). Further details of sampling methods, tracing and response rates have been previously described.<sup>3</sup>

### MEASUREMENT OF RISK FACTORS

#### Specific military factors

We asked which Service of the Armed Forces—Royal Navy including Royal Marines, Army or the Royal Air Force—the participant was in at the time of deployment. Rank was classified

into three categories; privates (and their equivalents); non-commissioned officers (NCOs); and officers. NCOs are usually personnel who have moved up the ranks through merit, whereas officers are commissioned into the military, usually with a higher level of education and officer training before joining. We categorised the serviceman's main role during deployment as within a Combat Services Support Arm, Combat Support Arm or Combat Arm, according to accepted military classification of combat status of Corps. We asked whether he was a reservist or regular at the time of deployment, and whether he was currently serving.

#### Deployment factors

Team support was labelled "Unit status" and measured by asking the respondent whether he had been deployed with his Unit, part of his Unit or as an individual reinforcement to a different Unit. We also asked whether he had received pre-deployment training and whether he had post-deployment leave.

#### Sociodemographic factors

We measured age on 1 January 1991, marital status, alcohol consumption per week and smoking when completing questionnaire and pre-military educational attainment.

### MEASUREMENT OF OUTCOMES

As there is no consensus on the definition of Gulf related ill health we used two physical health status measures, fatigue and physical symptoms and two mental health status measures, psychological distress and post-traumatic stress. We defined a fatigue case as a score of 4 or above using the Chalder Fatigue questionnaire.<sup>8</sup> We derived a measure of the Centers for Disease Control and Prevention (CDC) case definition of multisymptoms in Gulf War veterans<sup>1</sup> using a standardised 50 item symptom questionnaire as previously described.<sup>3,9</sup> We defined psychological distress as a score of >2 on the General Health Questionnaire-12.<sup>10</sup> We labelled a proxy measure of post-traumatic stress as "post-traumatic stress reaction" based on symptoms in our questionnaire that matched the three symptom groups for diagnosis of post-traumatic stress disorder, intrusive thoughts, avoidance and arousal, respectively.<sup>3,11</sup>

### STATISTICAL ANALYSES

SPSS 8.1 and STATA 5 statistical packages were used to store and analyse the data, respectively. Multivariate analysis, using logistic regression, was used to adjust the association between military, sociodemographic and lifestyle variables and each health outcome, and reported as odds ratios and 95% confidence intervals. Test for trend was performed for ordered categorical variables (age, education, smoking, alcohol intake, rank and combat arm) using the likelihood ratio test statistic. We examined the univariate and multivariate associations between Unit status (Army only), pre-deployment training and post-deployment leave with military, sociodemographic and

Table 1 Number of individuals† (% cases) in each category and multivariate odds ratios (95% confidence intervals) using logistic regression for fatigue and CDC syndrome in Gulf male veterans

Explanatory variable	Fatigue		CDC syndrome	
	Number of individuals (% cases)	Adjusted* odds ratio	Number of individuals (% cases)	Adjusted* odds ratio
<b>Age group (y)</b>				
<20	292 (51.4)	1	302 (17.6)	1
20–29	1883 (46.6)	1.0 (0.7,1.3)	1924 (16.4)	1.2 (0.8,1.7)
30–39	809 (47.0)	1.0 (0.7,1.4)	833 (18.1)	1.4 (0.8,2.2)
≥40	179 (43.0)	1.1 (0.6,2.1)	191 (18.3)	2.8 (1.3,5.9)
<b>Education</b>				
< O levels/GCSEs	598 (56.9)	1	621 (22.4)	1
O levels/GCSEs	1863 (46.4)	0.7 (0.6,0.9)	1911 (16.6)	0.8 (0.6,1.0)
A levels and >	603 (35.5)	0.8 (0.8,1.4)	617 (10.7)	0.8 (0.5,1.3)
<b>Marital status</b>				
Married	2397 (45.6)	1	2454 (16.0)	1
Single	476 (46.9)	1.1 (0.8,1.4)	493 (17.2)	1.1 (0.8,1.5)
Ex married	274 (56.9)	1.2 (0.9,1.7)	286 (25.2)	1.8 (1.2,2.5)
<b>Alcohol intake</b>				
None	243 (54.3)	1	253 (25.7)	1
<21 units	2485 (46.8)	0.7 (0.5,1.0)	2541 (16.3)	0.6 (0.4,0.9)
>21 units	420 (43.6)	0.6 (0.4,0.9)	439 (16.4)	0.6 (0.6,1.0)
<b>Smoking</b>				
Current	1161 (55.6)	1	1192 (23.9)	1
Ex smoker	762 (44.5)	0.8 (0.7,1.0)	783 (15.7)	0.8 (0.6,1.0)
Non-smoker	1221 (40.0)	0.7 (0.6,0.8)	1255 (11.6)	0.6 (0.4,0.7)
<b>Service</b>				
Army	2397 (50.2)	1	2470 (19.4)	1
Royal Navy	271 (38.9)	0.9 (0.2,3.1)	276 (9.8)	‡
Royal Air Force	447 (36.2)	2.1 (0.6,7.3)	453 (10.6)	1.2 (0.3,5.9)
<b>Regular status</b>				
Regular	2966 (47.4)	1	3044 (17.3)	1
Reservist	48 (45.8)	1.0 (0.4,2.2)	49 (20.4)	0.7 (0.2,2.3)
<b>Rank</b>				
Private	1180 (50.8)	1	1215 (19.7)	1
Non-commissioned officer	1577 (48.7)	0.9 (0.7,1.1)	1617 (17.8)	0.8 (0.6,1.0)
Officer	328 (29.0)	0.5 (0.3,0.8)	337 (6.5)	0.3 (0.1,0.6)
<b>Combat arm</b>				
Combat Services Support	991 (50.6)	1	1017 (20.4)	1
Combat Support	1066 (49.3)	0.9 (0.8,1.1)	1094 (18.3)	1.0 (0.8,1.2)
Combat	144 (60.4)	1.5 (1.0,2.2)	150 (22.7)	1.2 (0.8,1.9)

\*Adjusted for all other variables in table. †Denominators for each outcome differ slightly because of missing values on some items. ‡Empty cell.

Table 2 Number of individuals† (% cases) in each category and multivariate odds ratios (95% confidence intervals) using logistic regression for psychological distress and posttraumatic stress reaction in Gulf male veterans

Explanatory variable	Psychological distress		Post-traumatic stress reaction	
	Number of individuals (% cases)	Adjusted* odds ratio	Number of individuals (% cases)	Adjusted* odds ratio
<i>Age group (y)</i>				
<20	296 (37.8)	1	303 (17.5)	1
20–29	1888 (39.7)	1.3 (0.9,1.7)	1937 (13.4)	1.0 (0.7,1.5)
30–39	821 (39.0)	1.3 (0.9,1.8)	849 (12.1)	1.0 (0.6,1.7)
≥40	188 (38.3)	1.8 (1.0,3.2)	194 (8.8)	0.9 (0.4,2.3)
<i>Education</i>				
< O levels/GCSEs	609 (43.3)	1	630 (17.5)	1
O levels/GCSEs	1884 (39.2)	0.9 (0.7,1.1)	1926 (12.8)	0.7 (0.5,0.9)
A levels and >	603 (33.2)	0.9 (0.7,1.3)	624 (9.1)	0.9 (0.5,1.4)
<i>Marital status</i>				
Married	2407 (36.8)	1	2478 (11.5)	1
Single	487 (40.7)	1.2 (0.9,1.5)	496 (16.5)	1.4 (1.0,2.0)
Ex married	283 (56.2)	2.2 (1.6,3.0)	292 (21.6)	2.0 (1.4,2.9)
<i>Alcohol intake</i>				
None	248 (43.5)	1	256 (15.2)	1
<21 units	2501 (38.8)	0.9 (0.6,1.2)	2564 (12.4)	1.1 (0.7,1.8)
>21 units	428 (38.8)	0.8 (0.5,1.2)	446 (16.1)	1.3 (0.8,2.3)
<i>Smoking</i>				
Current	1167 (46.6)	1	1206 (19.3)	1
Ex smoker	773 (36.1)	0.8 (0.7,1.0)	788 (11.2)	0.6 (0.5,0.9)
Non-smoker	1234 (33.8)	0.7 (0.6,0.9)	1268 (8.6)	0.5 (0.4,0.7)
<i>Service</i>				
Army	2424 (41.9)	1	2473 (15.7)	1
Royal Navy	276 (31.5)	0.3 (0.1,1.6)	276 (5.8)	‡
Royal Air Force	444 (10.8)	0.7 (0.2,2.5)	455 (6.1)	0.8 (0.1,6.6)
<i>Regular status</i>				
Regular	2992 (39.5)	1	3049 (13.4)	1
Reservist	48 (37.8)	0.7 (0.3,1.7)	50 (17.0)	2.0 (0.7,5.4)
<i>Rank</i>				
Private	1189 (42.3)	1	1218 (16.1)	1
Non-commissioned officer	1596 (40.2)	0.8 (0.6,0.9)	1620 (13.3)	0.9 (0.6,1.1)
Officer	330	0.5 (0.3,0.8)	337 (5.0)	0.3 (0.2,0.7)
<i>Combat arm</i>				
Combat Services Support	999 (44.4)	1	1019 (16.8)	1
Combat Support	1076 (40.1)	0.9 (0.7,1.0)	1096 (13.9)	0.8 (0.6,1.0)
Combat	150 (41.3)	1.0 (0.7,1.4)	150 (16.7)	0.9 (0.5,1.6)

\*Adjusted for all other variables in table. †Denominators for each outcome differ slightly because of missing values on some items. ‡Empty cell.

lifestyle variables. We also used the likelihood ratio test statistic to examine whether the effect of Combat Arm on each of the health outcomes was modified by Unit status and/or rank in Army servicemen. Cases with missing data were excluded.

## Results

Three mailings were conducted from August 1997 to June 1998. The response rate was 70% (n=2735). In addition, a small proportion of respondents from a Bosnia comparison sample (n=562) who had also served in the Gulf were taken to be part of Gulf cohort.<sup>3</sup> Responders were slightly older and more likely to be still in service; details of this have been published.<sup>3</sup>

The distribution of, and adjusted odds ratios for fatigue and CDC syndrome cases in each military, sociodemographic and lifestyle category, is shown in table 1. These analyses are repeated for psychological distress and post-traumatic stress reaction in table 2. There was no association between the Service, Combat Arm or reservist status and any of the four health outcomes. There was a significant inverse relation between increasing rank and all health outcomes; fatigue (p=0.015), CDC syndrome (p=0.002), psychological distress (p=0.004) and post-traumatic stress reaction (p=0.002).

There was no association between increasing age and any of the four health outcomes, except that servicemen ≥ 40 years old were significantly more likely to have psychological distress and CDC syndrome compared with servicemen < 20 years old. There was a small significant trend between educational attainment before joining the Armed Forces and fatigue (p=0.036).

Divorced, separated or widowed status was significantly associated with CDC syndrome, psychological distress and post-traumatic stress reaction but not with fatigue.

There was a linear trend between smoking and all health outcomes; fatigue (p<0.00001), CDC syndrome (p<0.00001) and psychological distress (p<0.00001) and post-traumatic stress reaction (p<0.0001), but none with alcohol consumption.

At time of the survey, 57% (n=1967) of Gulf veterans had left the Armed Forces. After adjusting for the potential confounders listed in table 1, those who had left were more likely to have fatigue (odds ratio=1.4, 95% confidence intervals (95%CI) 1.2, 1.7), CDC syndrome (odds ratio=1.8, 95%CI 1.5, 2.3), psychological distress (odds ratio=1.6, 95%CI 1.3, 1.9), and post-traumatic stress reaction (odds ratio=2.5, 95%CI 1.9, 3.2).

Forty nine per cent (n=1236) of Army servicemen were deployed with their Unit, 35% (n=855) were deployed with part of their Unit and 15% (n=358) were deployed as an individual reinforcement. In both univariate and multivariate analysis, there was no association between Unit status and any health outcome (table 3).

Eighty three per cent (n=2660) of Gulf veterans undertook pre-deployment training. Pre-deployment training was associated with an

Table 3 Unadjusted and adjusted† odds ratios using logistic regression of the association between deployment factors and all four health outcomes

	Fatigue		CDC syndrome		Psychological distress		Post-traumatic stress reaction	
	Odds ratio	Adjusted odds ratio	Odds ratio	Adjusted odds ratio	Odds ratio	Adjusted odds ratio	Odds ratio	Adjusted odds ratio
<i>Unit status*</i>								
Deployed with whole Unit	1	1	1	1	1	1	1	1
Deployed with part of Unit	1.0 (0.9, 1.1)	0.9 (0.8, 1.1)	1.1 (0.9, 1.3)	1.0 (0.8, 1.3)	1.1 (0.9, 1.3)	1.0 (0.9, 1.3)	1.1 (0.9, 1.4)	1.1 (0.8, 1.4)
Deployed as an individual reinforcement	0.8 (0.7, 1.1)	1.0 (0.8, 1.3)	1.0 (0.7, 1.3)	1.1 (0.8, 1.6)	1.0 (0.8, 1.2)	1.1 (0.8, 1.4)	0.8 (0.6, 1.2)	0.9 (0.6, 1.3)
<i>Predeployment training</i>								
Yes	1	1	1	1	1	1	1	1
No	0.8 (0.6, 0.9)	1.1 (0.8, 1.4)	0.8 (0.6, 1.0)	0.6 (0.5, 0.9)	0.8 (0.7, 1.0)	1.0 (0.7, 1.3)	0.6 (0.5, 0.9)	0.8 (0.5, 1.2)
<i>Post-deployment leave</i>								
Yes	1	1	1	1	1	1	1	1
No	0.9 (0.8, 1.1)	0.9 (0.7, 1.2)	1.2 (0.9, 1.4)	1.2 (0.9, 1.7)	1.2 (0.9, 1.4)	1.2 (0.9, 1.5)	1.0 (0.8, 1.3)	1.1 (0.8, 1.6)

\*In Army only. †Adjusted for age, education, marital status, smoking status, alcohol consumption, rank, reserve status, combat arm and Service.

Table 4 Adjusted† odds ratios for post, traumatic stress reaction by Combat Arm, stratified by Unit Status, in Gulf Army veterans

Combat Arm	Deployed with whole Unit (n=1026)	Deployed with part of Unit (n=724)	Deployed as an individual reinforcement (n=290)
Combat	1	1	1
Combat Support	0.9 (0.5, 1.8)	1.1 (0.4, 3.1)	0.1 (0.0, 0.7)‡
Combat Services Support	0.9 (0.5, 1.8)	1.6 (0.6, 4.6)	0.1 (0.0, 1.0)*

†Adjusted for age, education, marital status, smoking status, alcohol consumption, rank, regular status.

‡p=0.03

\*p=0.05

increased likelihood of all four health outcomes but the relation disappeared after adjusting for potential confounding (table 3), except for CDC syndrome. Eighty four per cent (n=2466) of Gulf veterans took post-deployment leave. Both univariate and multivariate associations between post-deployment leave and each of the four health outcomes were not significant (table 3).

The only evidence of effect modification was that Unit status weakly modified the association between Combat Arm and post-traumatic stress reaction (likelihood ratio test:  $\chi^2$  (degrees of freedom) =9.0 (4), p=0.06). Stratifying by Unit status, the adjusted association between Combat Arm compared with a non-combat Arm and post-traumatic stress reaction was greatest in those who were deployed as an individual reinforcement to a different Unit (table 4).

### Discussion

Our main findings were that rank was associated with all health outcomes; privates were around 20% more likely to report ill health than non-commissioned officers and around 70% more likely to report ill health than officers. Ex-service Gulf veterans were around two times more likely to report psychological and physical ill health.

This study is population-based, used a randomly selected representative sample of the population of UK Gulf veterans. Our questionnaire used self reporting six to seven years since deployment, which may lead to a reporting bias.<sup>12,13</sup> The outcomes we used were approximations of health status. We used a cross sectional design from which causal relations cannot be inferred reliably.

The association between rank and ill health has been observed in US Gulf veterans,<sup>1,6</sup> but the explanations are not immediately clear. It is unlikely that rank is a proxy for exposures such as organophosphate pesticides, suspected chemical weapons or immunisations as most personnel, regardless of rank, could have been exposed where there was any exposure. It is more appropriate to consider rank as a proxy indicator of socioeconomic status,<sup>14</sup> which is associated with both psychological<sup>15</sup> and physical morbidity<sup>16,17</sup> in civilian populations. Rank incorporates formal qualifications, income and experience and perhaps unhealthy lifestyles, although when we adjusted for the latter the effect of rank persisted. Rank status may parallel employment grades in civil servants where low job control in lower grades is associated

### KEY POINTS

- Rank seems to be the main occupational factor associated with ill health in Gulf veterans.
- Health of those who had left the Armed Forces at the time of the survey was worse than those who were still serving.
- Pre-deployment training and post-deployment leave seem not to be associated with ill health in Gulf veterans.
- As in civilian populations, certain sociodemographic and lifestyle factors such as marital status and smoking are associated with ill health in Gulf veterans.

with increased risk for coronary heart disease.<sup>18</sup> It is possible that healthy servicemen of lower rank were less likely to participate although we did not find any significant non-response bias.<sup>3</sup> Also potential confounding by pre-deployment health status cannot be ruled out.<sup>19</sup>

The lack of association between Combat Arm and ill health has also been reported in US Gulf veterans,<sup>19</sup> but not in Danish peacekeepers<sup>20</sup> or Vietnam veterans.<sup>21-23</sup> One explanation is that since the Vietnam War, the nature of conflicts has changed (shorter wars, sophisticated technology and increased peace-keeping). During the Gulf conflict the ground attack lasted only four days whereas chemical and biological weapons were a real threat for a longer time and beyond the immediate geographical frontline.

Army servicemen were no more likely to have health problems compared with the Navy or Air Force, suggesting little difference in levels of exposure, if any, to combat or environmental toxins between Services. We also did not find a significant difference between reservist and ill health, unlike several US studies,<sup>1,2,6</sup> perhaps because the proportion of British reservists was less than 2%, compared with 20% in the US.

Military discharge was associated with both physical and psychological ill health. A healthy worker effect may be a partial explanation as fitness training is integral to military life whereas civilian life is more sedentary.

The most likely explanation for the lack of association between age and ill health is that our sample was young. Except for a weak protective effect of pre-military qualifications on fatigue, educational attainment was not associated with health problems, unlike previous reports in Vietnam veterans.<sup>22,23</sup> Perhaps recruits gain qualifications while they are serving. Gulf veterans who were divorced, separated or widowed were around twice as likely to report psychological problems than married or cohabiting veterans, similar to associations in civilian populations.<sup>24</sup>

The association between smoking and reporting both physical and psychological ill health has also been reported in US Gulf veterans<sup>1</sup> and in civilian populations.<sup>25-27</sup> Alcohol consumption is reputedly high in military

personnel<sup>28</sup> but we did not find this in our study, probably because of a reporting bias.

Fifteen per cent of Army servicemen were deployed as an individual reinforcement and there was some evidence that this increased ill health but only in the Combat Arm. Social support is related to health in civilian workforces.<sup>29</sup> Perhaps non-combat personnel are protected from lack of social bonds while away from their Unit because their skills require them to function independent of their unit. In contrast with our expectations, neither pre-deployment training or post-deployment leave was significantly associated with ill health.

This study suggests that rank, and perhaps being deployed as an individual reinforcement in a combat role, are associated with poor health in UK Gulf veterans. Our findings do not support the case for specific environmental exposures in the Gulf. Discharge from the military seems to be strongly associated with poor health, as was divorce and smoking. These findings need replicating and prospective studies are required to test their predictive importance.

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#### Contributors

KI contributed to study hypothesis, analysis, drafted and preparation of manuscript; NB creation of study cohorts, preparation of manuscript; MH statistical advice, preparation of manuscript; LH implementing study; IP Grant holder, military advice; CU study coordinator; TD and SW principal investigators, generated hypotheses, planned, designed and supervised study, preparation of manuscript.

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