

RESEARCH

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Data were accessed for research purposes by the corresponding author on 2nd of May 2023. Authors did not have access to information that could identify individual participants.

The study used weights, as provided by the data, to account for sampling design effects and potential response bias. These weights were calculated based on the German Microcensus data, incorporating adjustments for household selection probability, regional distribution, and sociodemographic characteristics. The weighting procedure ensured representativeness of the sample with respect to federal state, urbanization, household size, occupational status, and key demographic variables. However, similar results were obtained when using unweighted analyses [35, 36]. The original dataset included 60,048 cases. After deleting 1072 cases with missing values listwise (1.79%), 58,976 cases remained for the analysis. Most cases were omitted due to missing values in the variables “occupation” (293 cases) and “psychosomatic complaints” (291 cases).

#### Demographic and sociodemographic measures

Variables used in the analysis were gender, age, working hours, parental status, and occupation. Gender was treated as a binary nominal variable (“male”, “female”). Age was treated as a continuous metric variable. Working hours was treated as binary nominal variable (“full-time” meaning 36 h or more, “part-time” meaning less than 36 h). It was included as a covariate due to the finding that long working hours (more than 35 h/week) are associated with diminished well-being, although the literature is not entirely conclusive [37, 38]. Parental status was treated as a binary nominal variable (“yes”, “no”). It was included as a covariate due to findings that balancing work and family can increase rates of chronic illness and poorer self-rated health [39]. The self-selected occupation of the participants was classified by the data owners using the ISCO88 one-digit coding.

The 10 major groups in the data set were the following: Code 1 included legislators, senior officials, managers, code 2 included professionals, code 3 included technicians and associate professionals, code 4 included clerks, code 5 included service workers, shop and market sales workers, code 6 included skilled agricultural and fishery workers, code 7 included craft and related trades workers, code 8 included plant and machine

## Data analyses

First, descriptive analyses were calculated in terms of absolute and relative frequencies for each year of the sample.

Given our use of a non-validated psychosomatic complaint score, we conducted both exploratory and confirmatory factor analyses to assess its psychometric properties. The principal-component factor analysis employed the Kaiser criterion, which retains only factors with eigenvalues greater than or equal to 1. Additionally, Cronbach's Alpha and McDonald's Omega were calculated as well as Horn's parallel analysis for principal component analysis.

The repeated calculation of mean differences in psychosomatic complaints for each wave was done via t-tests. With three waves and four collar plus an overall wave value, this resulted in  $3 \times 5 = 15$  t-tests. The significance of mean differences between genders was additionally tested through weighted linear regression for each year to control for covariates, stratifying for each occupational subgroup plus an overall value over all occupational subgroups using an  $\alpha$ -level of 5% for each subgroup. Gender was used as independent variable; psychosomatic complaint score was used as dependent variable. Age, parental status and working hours were used as covariates. Effect sizes for the same groups were calculated using Cohen's *d* [42]. Furthermore, we first estimated a weighted regression model without interaction effects to estimate direct effects of gender and wave after controlling for the covariates age, parental status, collar and working hours. Then, we estimated a weighted interaction regression model to test if the gender differences did change over time. A weighted interaction model using linear regression was conducted to examine the interaction of gender (categorical variable with two conditions) and wave (categorical variable with three conditions) on psychosomatic complaint score. Age, parental status, collar and working hours were used as covariates. All analysis were performed using StataMP 15.

## Results

### Basic characteristics of the study sample

As displayed in Table 1, of all participants in wave 2006, 48.61% were female; in wave 2012 52.53% were female and in wave 2018 49.76% were female. As seen in Table A1 in the Appendix, of all participants in wave 2006, mean age was 41.31 ( $SD=10.46$ ) years, in wave 2012 mean age was 46.06 ( $SD=10.70$ ) years and in wave 2018 mean age was 47.22 ( $SD=11.31$ ) years. The proportion of white-collar high-skilled workers in the samples grew from 53.13% in wave 2006 to 55.07% in wave 2012 and to 63.97% in wave 2018. The proportion of white-collar low-skilled workers developed from 21.18% in wave 2006 to 21.37% in wave 2012 to 17.05% in wave 2018. The proportion of blue-collar high-skilled workers decreased from 14.27% in wave 2006 to 12.74% in wave 2012 to 9.78% in wave 2018. The proportion of blue-collar low-skilled workers decreased from 11.42% in wave 2006 to 10.82% in wave 2012 to 9.20% in wave 2018. As displayed in Table 1, the occupational subgroup of high-skilled white-collar workers in each year was nearly divided equally in men and women. White-collar low-skilled and blue-collar low-skilled jobs were female-dominated, blue-collar high-skilled jobs were male-dominated.

Multiple psychometric methods confirmed that our psychosomatic symptoms form a single underlying factor of psychosomatic symptom burden. First, in accord-

("headache") to 0.85 ("depressed mood"), supporting the psychometric validity.

#### Gender differences in psychosomatic symptoms stratified by occupational groups

As displayed in Table 2, of all participants in 2006, an overall numerical mean difference of  $D_{\text{male/female}} = 0.24$  points and an effect size of 0.16 emerged between genders, with women having more symptoms, 95% CI [0.30; 0.41]. Regarding occupational subgroups, there were significant gender differences in white-collar high-skilled, white-collar low-skilled and blue-collar high-skilled jobs after controlling for the covariates age, parental status and working hours. The biggest difference was observed in white-collar high-skilled jobs with an effect size of 0.23 and 95% CI of [0.31; 0.46] when controlling for the mentioned covariates. Of all participants in 2012, an overall numerical mean difference of  $D_{\text{male/female}} = 0.37$  points and an effect size of 0.23 (95% CI [0.42; 0.55]) emerged, with women having more symptoms. Regarding occupational subgroups, gender was a significant predictor as the exposure of primary interest in all occupational subgroups after controlling for the covariates age, parental status and working hours. The biggest difference is observed in white-collar high-skilled jobs with an effect size of 0.30 and 95% CI of [0.50; 0.66] when controlling for the mentioned covariates. Of all participants in 2018, an overall numerical mean difference of  $D_{\text{male/female}} = 0.35$  points and an effect size of 0.22 emerged,

with women having more symptoms (95% CI [0.37; 0.51]). Regarding occupational subgroups, gender was a significant predictor as the exposure of primary interest in white-collar high-skilled, white-collar low-skilled jobs and blue-collar low-skilled jobs (expant 90000154m(tr)6(9618(pt)6.1(



## Discussion

Using three waves (2006, 2012, and 2018) of the nationwide German employment survey, we analysed gender differences in psychosomatic complaints across occupational categories. We classified occupations into four subgroups: high-skilled and low-skilled positions in both white-collar and blue-collar sectors. Our analysis revealed a persistent and partly widening gender disparity in psychosomatic complaints across occupational subgroups. Women reported significantly higher levels of complaints compared to men, independent of age, parental status, and working hours but especially pronounced in high-skilled white-collar occupations. This gender gap expanded over the twelve-year period, confirming and extending previous research on gender differences in workplace-related psychosomatic symptoms [6–10].

Regarding the overall trend over time, the magnitude of gender differences in psychosomatic complaints significantly increased from 2006 to 2012, with effect sizes







**Competing interests**

The authors declare no competing interests.

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