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Police officers' work-life balance, job satisfaction and quality of life – Longitudinal effects after changing the shift schedule

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POLICE OFFICERS' WORK-LIFE BALANCE

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5 1 **POLICE OFFICERS' WORK-LIFE BALANCE, JOB**
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7 2 **SATISFACTION AND QUALITY OF LIFE – LONGITUDINAL**
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10 3 **EFFECTS AFTER CHANGING THE SHIFT SCHEDULE**
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ABSTRACT

Objectives: To evaluate mental health-related outcomes of police officers five and a half years after implementing a new alternating shift schedule which was supposed to improve their health and work-life balance.

Design: Pre-post study design with a baseline survey at the beginning of the piloting of the new shift schedule in 2015 and another survey five and a half years later in 2020.

Setting: Police departments of a German metropolitan police force piloting the new shift schedule.

Participants: 116 shift-working police officers out of a population of 1673 police officers at the follow-up date.

Interventions: New shift schedule based on occupational health recommendations.

Outcomes measures: Work-life balance, job satisfaction and quality of life.

Methods: Mixed analyses of variances were used to test the hypotheses of within- and between-subject differences with regard to time and gender.

Results: We found partly significant differences between the baseline and follow-up survey for work-life balance ($F(1, 114) = 6.168, p = .014, \eta_p^2 = .051$), job satisfaction ($F(1, 114) = 9.921, p = .002, \eta_p^2 = .080$) and quality of life ($F(1, 114) = .593, p = .443, \eta_p^2 = .005$). Neither significant differences between male and female police officers nor interaction effects of time and gender were found.

Conclusion: An increase was found for each of the three outcomes five and a half years after implementing the new shift schedule. The results contribute to the current state of research on mental health-related outcomes of working conditions in shift work. On this basis, recommendations for designing shift schedules can be deduced to promote mental health and job satisfaction for employees in shift work.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study used longitudinal data to examine changes in mental health-related outcomes among shift-working police officers before and after implementing a new shift schedule.
- The results contribute to a deeper understanding of mental health outcomes associated with working conditions in shift schedules.
- The study was designed and conducted by an interdisciplinary team of psychologists, occupational physicians, health scientists and epidemiologists.

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40 • Only a small proportion of the surveyed police officers could be matched over the measurement
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5 41 points, resulting in a reduced sample size and limited representativity of results.
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INTRODUCTION

Police officers are exposed to various work-related demands in their jobs, with shift work being an inevitable one of them. Working in shifts, especially at night, is associated with several health risks, such as higher incidences of cardio-vascular diseases resulting from a disturbed circadian rhythm¹⁻³ and a potentially increased risk of cancer due to impaired melatonin secretion⁴⁻⁷. Furthermore, alternating shift work is associated with increased risk of sleep disturbances⁸, impaired mood and performance, and disrupted family and social relationships, which in turn can have a negative impact on physical and mental health⁹⁻¹³. Balancing work and leisure activities, such as partnership, family, caring for relatives, hobbies or voluntary work, thus poses a particular challenge for employees working in alternating shifts¹⁴. Among shift-working police officers, work-family conflict has already been associated with higher levels of job dissatisfaction¹⁵⁻¹⁸, burnout and stress¹⁹⁻²¹, more subjective health complaints and even suicidal ideation²². Although significant gender differences, in general, but especially among police officers who were married and/or had children, were found regarding psychosocial stress²³, further research findings highlight the significant relationship between stress and work-life balance²⁴ or work-family conflict^{25 26} affecting police officers regardless of their gender. Similarly, several studies indicate that gender does neither predict police officers' job satisfaction nor differ significantly between males and females²⁷⁻²⁹, although contradictory results have been found^{30 31}. Literature also provides inconsistent findings on police officers' gender and perceived quality of life. A Greek study suggests that female and male police officers' scores do not differ significantly overall, but females reported lower levels of subscales of health-related quality of life which is – like job satisfaction – negatively associated with perceived stress. However, significant interactions were not revealed³¹. Other studies have found no significant gender differences concerning police officers' quality of life³². However, research on police officers' quality of life is only recently emerging^{33 34}. In this context, an evaluation at a German metropolitan police force revealed an improved work-life balance among police officers after adapting the shift schedule according to occupational health recommendations^{35 36}. Especially flexibility due to improved planning of free time and shorter shifts were regarded as more compatible with family and leisure time activities³⁶. In a similar vein, a German metropolitan police force aspired to adapt their alternating shift schedule and evaluate their newly-developed shift schedule to improve their employees' health, work-life balance, job satisfaction and general health. The shift schedule was thus changed from a four-week rotation with 35 to 49 hours of work per week to an eight-week rhythm with 36 to 48 hours of work per week. The early duty week with six consecutive early mornings, at 5:30 a.m. and one Sunday off was abolished. Previously alternating day, late and night shifts, with 12.25 hours-day and night shifts in three subsequent weeks and days off (so-called "sleep-in days") after night shifts following this early duty week were replaced

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3 76 by two night shifts followed by two or three days off each week, resulting in at least one day off after
4 77 the "sleep-in day". In contrast to the previous shift schedule, the new system also stipulated
5 78 guaranteed days off without availability for special operations. 12-hour day and night shifts now
6 79 usually occurred twice a week, in some weeks only once. A comparison of both shift schedule models
7 80 with regard to occupational health recommendations is provided in the supplementary materials'
8 81 Table S1.

82 Objectives and hypotheses

83 As described above, the current state of research provides evidence that shift work can lead to work-
84 family conflicts and affect mental health and job satisfaction among police officers. However, there is
85 considerably less longitudinal research data demonstrating the effects of shift work systems on work-
86 and health-related outcomes. As part of a broader evaluation of the potential effects of the new shift
87 schedule on the working conditions at the metropolitan police, the aim of this study was to investigate
88 within-and between-subject psychological effects of the new shift schedule. Further results of
89 occupational health analyses³⁷ as well as analyses of sickness absence rates³⁸ are presented in separate
90 articles. Within the evaluation process of the new shift schedule we thus explored in the present study:
91 How does the newly-introduced shift schedule impact police officers' work-life balance, job
92 satisfaction and quality of life? Is there a significant difference in work-life balance, job satisfaction and
93 quality of life at the two time points before and after implementing the new shift schedule or regarding
94 their gender?

95 In light of the state of research outlined above, we accordingly formulated the following hypotheses:

96 H_{1a}: Police officers' perceived work-life balance will be significantly higher rated five and a half years
97 after implementing the new shift schedule.

98 H_{1b}: There will be no significant main effect of gender on police officers' perceived work-life balance.

99 H_{1c}: There will be no significant interaction effect of police officers' gender and time on their perceived
100 work-life balance.

101 H_{2a}: Police officers' job satisfaction will be significantly higher five and a half years after implementing
102 the new shift schedule.

103 H_{2b}: There will be no significant main effect of gender on police officers' job satisfaction.

104 H_{2c}: There will be no significant interaction effect of police officers' gender and time on their job
105 satisfaction.

106 H_{3a}: Police officers' perceived quality of life will be significantly higher five and a half years after
107 implementing the new shift schedule.

108 H_{3b}: There will be no significant main effect of gender on police officers' perceived quality of life.

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109 H_{3c}: There will be no significant interaction effect of police officers' gender and time on their perceived
110 quality of life.

111 METHODS

112 Study design, population and recruitment

113 The newly-proposed shift schedule was piloted in a German metropolitan police force in a successive
114 roll-out across all police stations (PS). In May 2015, the first metropolitan PS introduced the new shift
115 schedule, followed by six other PS until the end of 2015. 16 further PS and the operations centre
116 introduced the new shift schedule until September 2017, one last PS changed their shift schedule in
117 the beginning of 2021. Data were collected at three time points using questionnaires. Only police
118 officers of four relevant duty groups who worked in the alternating shift schedule were included in the
119 study. Participating police officers worked at PS across the metropolitan area or the operations centre
120 where emergency calls are received and handled. The first survey took place shortly before the piloting
121 of the new rotating shift schedule started in May 2015 (T0), the second survey was conducted one year
122 later, in June 2016 (T1), followed by the third survey was scheduled exactly five years later in May 2020
123 but had to be postponed to December 2020 and early January 2021 due to the SARS-CoV-2 pandemic
124 (T2). Each time, standardised questionnaires with a covering letter were distributed via the official post
125 boxes to all police officers of the metropolitan police force working rotating shifts and belonging to the
126 predefined duty groups. Participants were asked to provide an individual matching code based on
127 digits and letters. The completed questionnaires could be placed anonymously in sealed ballot boxes
128 within four weeks. The paper questionnaires were then digitised with the data collection software
129 TeleForm® (Electric Paper Informationssysteme GmbH, Lüneburg, Germany). Despite the consistently
130 high response rates, owing to lack of consent, many retirements and new recruitments of police
131 officers in the meantime, only 127 participants could be matched between T0 and T2. A further
132 matching with T1-participants would have resulted in a sample size too small to analyse. Therefore,
133 only police officers participating in the baseline (T0) and follow-up (T2) surveys were matched. A
134 flowchart of this process is provided in Figure 1.

135 ---- insert Figure 1 here ----

136 Measures

137 Sociodemographic and job characteristics

138 We gathered information on participants' gender, age, rank within the police force, shift work
139 experience, type of employment and duty service, relationship status and number of children as well
140 as being a single parent or caring for relatives or others.

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141 **Work-life balance**

142 Work-life balance was measured with five items which were already deployed and considered reliable
143 (Cronbach's $\alpha = .92$) in a similar survey of another German metropolitan police force³⁶. A sample item
144 was "The coordination of my daily work routine with my private matters works well." All items were
145 rated on a five-point Likert scale (1 = "I fully agree" to 5 = "I do not agree") and calculated as a score
146 ranging from 0 (worst work-life balance) to 100 (best possible work-life balance).

147 **Job satisfaction**

148 We measured job satisfaction with seven items of the German version of the Copenhagen Psychosocial
149 Questionnaire (COPSOQ) job satisfaction scale³⁹. The items were presented on a four-point Likert scale,
150 ranging from 1 = "very satisfied" to 4 = "very unhappy". A sample item was "Regarding your work in
151 general. How pleased are you with your job as a whole, everything taken into consideration?" A score
152 was computed based on the items, ranging from 0 (lowest job satisfaction) to 100 (highest job
153 satisfaction). Both, the original and the latest COPSOQ study confirmed the German scale's validity and
154 reliability (Cronbach's α ranging from .79 to .82)^{39 40}.

155 **Quality of life**

156 Quality of life was assessed using two items of the World Health Organization's questionnaire
157 WHOQOL-Bref to calculate its global score ranging from 0 (worst quality of life) to 100 (best quality of
158 life)⁴¹. Participants responded to the questions "Over the last two weeks, how would you rate your
159 quality of life?" and "Over the last two weeks, how satisfied were you with your health?" on a scale
160 from 1 = "very bad/unsatisfied" to 5 = "very good/satisfied". The instrument in its short version can be
161 considered reliable (Cronbach's α ranging from .57 to .88) and valid⁴¹.

162 **Statistical analyses**

163 After calculating the scores for work-life balance and job satisfaction, the data were tested regarding
164 the assumptions of a mixed analysis of variance (mixed ANOVA). After a check for missing values and
165 multivariate outliers, 11 cases were excluded, resulting in a final sample size of $N = 116$. Although most
166 of the normality tests (Kolmogorov-Smirnov and Shapiro-Wilk) indicated no normality of the data,
167 based on the sample size ($N = 116$, $n > 30$ for each group), normal Q-Q plots, skewness and kurtosis
168 values (< 1.0), bivariate normal distribution of data could be assumed. The Pearson correlation matrix
169 further indicated no multicollinearity ($r < .63$). Box's test indicated homogeneity of covariance matrices
170 ($p > .05$) and Levene's tests indicated homoscedasticity ($p > .05$) in all mixed ANOVA. Mauchly's test
171 for sphericity was non-significant due to the analysis of two time points. Cohen's d was calculated from
172 η_p^2 and used to evaluate the effect sizes, considering $d = .20$ as a small effect, $d = .50$ as a medium
173 effect, and $d = .80$ as a large effect⁴². In addition, mean scores and standard deviations were calculated

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174 for each time point individually and a sensitivity analysis was conducted for the follow-up survey (T2)
 175 to account for the different lengths of time police officers had worked with the new shift schedule (in
 176 months) as a covariate. All statistical analyses were performed with IBM® SPSS® Statistics (version 25;
 177 IBM Corp; Armonk, New York, USA), $p < 0.05$ was considered as significant.

178 Patient and Public involvement

179 Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our
 180 research.

181 Ethical considerations

182 The study was approved by the Ethics Review Committee of the Hamburg Medical Association,
 183 Germany (PV4999 / WF-009/20). All participants provided informed consent for data collection after
 184 receiving information on data protection and analysis. Participants who did not provide informed
 185 consent were excluded from data analysis.

186 RESULTS

187 Participant characteristics

188 The majority of participants were male (70.7%). Most of the participating police officers were aged
 189 between 35 and 39 years (21.6 %; also median and modal age category) and worked in upper police
 190 service (65.5%). Two thirds of them had already worked in shift work for more than ten years (66.4%).
 191 Almost 90% worked fulltime and 68% had been predominantly on patrol duty in the past weeks before
 192 completing the survey. Participants also mostly lived in a permanent relationship (83.6%) and had at
 193 least one child (60.3%). Only less than 2% were single parents and slightly more (2.6%) cared for
 194 relatives or others alongside their job. Police officers' sociodemographic characteristics at baseline (T0)
 195 are provided in more detail in Table 1.

196 **Table 1. Sociodemographic characteristics of participants at baseline T0 (N = 116).**

Characteristics	<i>n</i>	%
Gender		
Male	82	70.7
Female	34	29.3
Age		
20-24 years	4	3.4
25-29 years	16	13.8
30-34 years	19	16.4
35-39 years	25	21.6
40-44 years	15	12.9

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45-49 years	17	14.7
50-54 years	19	16.4
≥ 55 years	1	.9
Rank		
Intermediate police service	40	34.5
Upper police service	76	65.5
Shift work experience		
≤ 5 years	21	18.1
5-10 years	18	15.5
≥ 10 years	77	66.4
Type of employment		
Part-time	12	10.3
Fulltime	104	89.7
Type of duty service ¹		
Exclusively office duty	22	19.0
Predominantly office duty	8	6.9
Office and patrol duty (50:50)	7	6.0
Predominantly patrol duty	79	68.1
Permanent relationship		
Yes	97	83.6
No	18	15.5
No information given	1	.9
Children		
None	46	39.7
One child	20	17.2
Two children	35	30.2
Three children	12	10.3
Four children	3	2.6
Single parent		
Yes	2	1.7
No	100	86.2
No information given	14	12.1
Caring for relatives/others		
Yes	3	2.6
No	113	97.4
Time working with the new shift schedule		
≤ 24 months	4	4.1
25-48 months	31	26.7
≥ 49 months	63	54.3
No information	18	15.5

197 Note. ¹Refers to type of service exercised in the last four weeks prior to taking the survey.

198 Descriptive statistics at all three time points indicated increasing mean scores with each survey. Work-
 199 life balance, job satisfaction and quality of life have been rated higher consecutively at each time point.
 200 For work-life balance and job satisfaction, the difference of means was greater over the longer period
 201 between T1 and T2 compared to T0 and T1. For quality of life, by contrast, the difference was greater
 202 between T0 and T1, whereas between T1 and T2 only a smaller difference of the mean could be
 203 observed, as displayed in Table S2 in the supplementary material.

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204 **Within-subjects effects of time**

205 The descriptive cross-sectional findings of each measurement point were also found in the matched
 206 sample of baseline and follow-up mean scores we used for the principal analyses. Means of all three
 207 dependent variables were higher at T2 than at T0 (see Table 2). The mixed ANOVA revealed significant
 208 small and medium-sized main effects for the within-subjects effects on police officers' work-life
 209 balance ($F(1, 114) = 6.168, p = .014, \eta_p^2 = .051, d = .464$) and job satisfaction ($F(1, 114) = 9.921, p = .002,$
 210 $\eta_p^2 = .080, d = .590$), thereby confirming hypotheses H_{1a} and H_{2a}. The main effect for quality of life was
 211 not significant ($F(1, 114) = .593, p = .443, \eta_p^2 = .005$). Hypothesis H_{3a} thus had to be rejected.

212 **Table 2. Means and standard deviations for work-life balance, job satisfaction and quality of life (N**
 213 **= 116).**

		Work-life balance		Job satisfaction		Quality of life	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
T0	Males ¹	50.305	21.305	66.148	11.538	62.805	17.675
	Females ²	57.794	22.670	65.314	10.308	65.809	19.294
	Total	52.500	21.884	65.904	11.153	63.685	18.131
T2	Males ¹	59.817	24.145	70.635	12.637	64.787	18.750
	Females ²	63.971	21.098	70.777	12.370	67.647	22.638
	Total	61.034	23.280	70.677	12.506	65.625	19.910

214 Note. ¹*n* = 82. ²*n* = 34.

215 **Between-subjects effects of gender and interactions**

216 Regarding the between-subjects effects, the mixed ANOVA showed that no significant main effect of
 217 gender ($F(1,114) = 3.046, p = .084, \eta_p^2 = .026$) on perceived work-life balance. While female police
 218 officers' mean rating increased by six points, their male colleagues' mean rating increased by almost
 219 ten points from T0 to T2 (see Table 2), the difference was not significant and both groups showed the
 220 same pattern. Therefore, no significant interaction between time and gender ($F(1,114) = .279, p = .598,$
 221 $\eta_p^2 = .002$) was found. Figure 2 illustrates that both, males and females showed a similarly sized
 222 increase for work-life balance across time. These findings support our hypotheses H_{1b-c}.

223 Likewise, no significant difference was found between male and female police officers with regard to
 224 their job satisfaction ($F(1,114) = .035, p = .851, \eta_p^2 = .000$), supporting hypothesis H_{2b}. Female and male
 225 participants' mean job satisfaction increased comparably from T0 to T2 (see Table 2). However, women
 226 reported marginally higher values at T2 (+.142 points compared to their male colleagues). Therefore,
 227 the profile plot in Figure 3 depicts slightly crossing lines. Nevertheless, in support of hypothesis H_{2c}, no

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228 significant interaction between time and gender ($F(1,114) = .095, p = .758, \eta_p^2 = .001$) was found for
229 job satisfaction either.

230 In line with hypothesis H_{3b}, we found no significant differences in quality of life means between males
231 and females ($F(1,114) = .956, p = .330, \eta_p^2 = .008$). Female police officers rated their quality of life higher
232 than their male colleagues at both time points but both means increased at the same rate (see Table
233 2). Therefore, no interaction between time and gender was found ($F(1,114) = .001, p = .977, \eta_p^2 = .000$),
234 as assumed in hypothesis H_{3c} and depicted in Figure 4.

235 ---- insert Figures 2-4 here ----

236 Sensitivity analyses with data from the follow up-survey (T2, $n = 893$ for work-life balance, $n = 881$ for
237 job satisfaction and $n = 907$ for quality of life) indicated that when controlling for the length of time
238 police officers had worked according to the new shift schedule, between-subject differences did not
239 change and remained insignificant regardless of whether the exposure duration was added to the
240 model or not.

241 DISCUSSION

242 In the present study, we analysed within- and between-subject differences of three work-related
243 mental health outcomes among police officers of a German metropolitan police department at two
244 time points. The baseline data were compared to the survey results five and a half years later, after
245 implementing a new shift schedule which was supposed to improve mental and physical health of the
246 police officers. Our findings provide support for most of our hypotheses: work-life balance and job
247 satisfaction scores significantly increased between the baseline survey and the follow-up. Quality of
248 life increased as well, but not to a statistically significant extent. At both time points, female police
249 officers reported higher levels of work-life balance and quality of life, whereas male participants rated
250 their job satisfaction higher at the baseline. However, no significant differences were found between
251 male and female police officers regarding their work-life balance, job satisfaction and quality of life.
252 Notably, the greatest increase over the five and a half years could be observed in the work-life balance
253 of police officers, followed by job satisfaction and quality of life.

254 Consistent with previous findings, restricted work-life balance due to the shift schedule affected male
255 and female police officers equally²⁴⁻²⁶. Sociodemographic characteristics revealed that most of the
256 participants had children and lived in a permanent relationship, whereas only very few participants
257 were single parents. This may indicate that parents shared their care for children or other relatives and
258 that traditional gender roles are being undone²⁴. However, work-life balance does not only include
259 balancing work and family matters but also social life and leisure activities. Our results are further

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260 supported by findings of a another German metropolitan police force that evaluated similar shift
261 schedules which served as a blueprint for the one we evaluated^{35 36}. Accordingly, shift schedules with
262 more flexible working time arrangements reduced the impact of work-life balance as a potential
263 stressor and that work-life balance was negatively related to police officers' perceived strain³⁵.

264 At both time points, job satisfaction means exceeded those reported by the international and German
265 general working population^{40 43}, indicating a high job satisfaction among our participants overall. In line
266 with our results, recent findings suggest that changing the shift schedule could have a positive
267 influence on police officers' job satisfaction⁴⁴. In partial contradiction with our findings, male police
268 officers reported lower job satisfaction compared to female colleagues in a Greek sample, while female
269 police officers reported lower values of health-related quality of life compared to their male
270 colleagues³¹. However, the slightly greater increase of job satisfaction ratings among female
271 participants in our sample could indicate a gradually closing gender gap with the new shift schedule in
272 this regard. Yet the results need to be interpreted very cautiously and need to be further evaluated in
273 the long-term, as the differences were small and not significant.

274 Compared to norm values, quality of life was rated lower in our sample at both time points⁴¹. A cross-
275 sectional study among criminal police officers also revealed lower health-related quality of life scores
276 compared to results from general populations³³. Nevertheless, it becomes apparent that the quality of
277 life marginally increased after implementing the new shift schedule, although to a non-significant and
278 lesser extent than work-life balance and job satisfaction. Further analyses indicated that the working
279 conditions of the new shift schedule, especially the increased number of 12-hour shifts, did not have
280 a detrimental impact on the police officers' quality of life³⁷. Why the scores for work-life balance and
281 job satisfaction but not for quality of life between males and females seem to align over time thus
282 remains unclear. As research on police officers' quality of life has been unfolding recently, future
283 research will hopefully provide more insights on such differences and further associations.

284 Limitations

285 Based on longitudinal data, we were able to examine changes in health-related outcomes among shift-
286 working police officers before and after implementing a new shift schedule and thus contributed to a
287 deeper understanding of these outcomes associated with working conditions in shift schedules.
288 However, some limitations need to be discussed. Although we were able to gather and analyse data
289 over three different time points, we could only evaluate the baseline and follow-up data in a
290 longitudinal design. Despite high response rates, lack of given consent to evaluate the data,
291 retirements and new recruits led to an insufficient sample size after matching participants across all
292 three time points. Since the piloting was carried out as a successive rollout, not all of the PS surveyed
293 had introduced the new shift schedule or had sufficient experience with the new shift schedule after

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one year (T1). We therefore dropped the data of the second evaluation for longitudinal analyses to present longer-term rather than short-term effects. Information on short-term changes one year after the baseline (i.e. piloting of the new shift schedule) are therefore not included in the present analyses. Due to the small sample size, we did not include the exposure duration of the new shift schedule as a covariate into the primary analysis. However, sensitivity analyses conducted on the larger data set of the cross-sectional data from the follow-up survey (T2) showed that the effects did not change when the covariate was added to the model. Although we were able to analyse a larger sample size by considering the baseline and follow-up only, the matched sample differs from the population of shift-working police officers at T2 in age and gender and is therefore not representative of the current metropolitan police force which is now younger and includes more female police officers³⁷, again due to retirements and new recruitments. The results from this sample might also not necessarily valid for other police forces. Moreover, the analysed data stem from self-reports of the participants and are thus susceptible to bias such as socially desirable answers. Motivational efforts may also have had an effect on the participants' responses, as the results of the evaluation served as a decision-making basis on the continuation of the piloted shift schedule. Furthermore, selection effects such as the healthy worker effect may influence the results. Answers from colleagues who were under a lot of strain, ill or not able to work, who retired early or changed their profession may have not been reflected in the results which may therefore appear more positive than they would be based on the whole relevant police work force. Lastly, merely effects up to five and a half years after implementing the new shift schedule became evident in this study. Longer-term effects will have to be further evaluated in the future in order to be able to assess the new shift schedule in this respect.

Implications for research and practice

Our results provide evidence that changing a shift schedule according to occupational health recommendations improved police officers work-life balance and job satisfaction. Nevertheless, it must be taken into account that according to German labour legislation the implementation of 12-hour duties, which is implemented based on European law, requires special permissions and should be strictly limited to the minimum necessary to cover the service. Working in shifts or at nonstandard hours interferes with leisure time and can thus restrict social life or even parenting functioning resources^{14 45}. The costs and benefits of longer duties and consecutive off-duty periods therefore must be weighed carefully. For a better work-life balance and prevention of detrimental health effects, shifts should be variable and predictable^{14 35 46}. This was implemented with the new shift schedule and also acknowledged in additional free text answers participants gave in the follow-up survey. In order to better balance police work with care work that occurs in specific stages of life, such as raising children or caring for relatives, more flexible working time models could be supportive. In relation to the entire

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3 328 working life, working time could be reduced in such phases, therefore enabling a better balance of
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5 329 private and professional life³⁵. After successfully implementing the new shift schedule, further health-
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7 330 promoting measures should be offered to police officers. Research findings suggest that educational-
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9 331 based family-friendly programmes should be established in PS⁴⁷. Moreover, several health promotion
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11 332 programmes for police forces have been evaluated recently⁴⁸⁻⁵⁰. In this vein, mindfulness-based health
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13 333 promotion was recently shown to be feasible and efficacious to improve quality of life among Brazilian
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15 334 officers⁴⁸. It is also recommended to identify police officers' risk factors for mental health early to be
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17 335 able to prevent and promote their quality of life⁵¹. Continuous participation of police officers should
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19 336 be maintained to shape and continuously adapt the change process of implementing the new shift
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21 337 schedule³⁵. Regularly conducted risk assessments can provide a basis for this and identify such
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23 338 stressors to counteract them preventively.

339 CONCLUSION

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26 340 The results of this longitudinal study demonstrated small positive changes five and a half years after
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28 341 adapting a German metropolitan police force's alternating shift schedule. The new shift schedule
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30 342 providing more 12-hour shifts as well as more off-duty days enabled police officers to better balance
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32 343 private and work-related demands regardless of their gender. The altered working conditions were
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34 344 also reflected in higher job satisfaction, whereas the increase in quality of life was not significant.
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36 345 Despite the benefits of more predictable scheduling and free time in the new shift schedule, more
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38 346 frequent 12-hour shifts during the day and night may entail adverse health effects in the long run.
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40 347 Therefore, larger cohort studies and evaluations over a longer period of time with several
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42 348 measurement points are recommended to verify the effects and continuously monitor its
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44 349 consequences for police officers.

44 STATEMENTS

45
46 350 **Dedication:** We respectfully dedicate this paper to the memory of our colleague Cordula Bittner (1968-
47
48 351 2019), who led the first part of the evaluation (2015-2016) ensuring a fruitful dialogue between
49
50 352 researchers and police, which laid the foundation for the further evaluation 2021.

51
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53
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55
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57
58 356 **Authors' contributions:** ER drafted the manuscript and conducted data analyses. ER, MVG and RH
59
60 357 prepared the data for analyses. ER, MVG, RH, AMP, CT, VH and SM participated in designing the study.

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359 MVG, RH, AMP, CT, VH and SM supervised the study and data analyses. MVG administered the project.
 360 MVG, RH, AMP, CT, VH and SM contributed in the drafting of the manuscript. All authors read and
 361 approved the final manuscript.

362 **Ethics approval:** The study was approved by the Ethics Review Committee of the Hamburg Medical
 363 Association, Germany (PV4999 / WF-009/20).

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365 **Competing interests:** All authors declare no competing interests.

366 **Data sharing statement:** The data cannot be made available due to the contractual provision with the
 367 cooperation partner.

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FIGURE LEGENDS

507 Figure 1: Participant flow chart across measurement points. Percentages in parentheses indicate
508 response rates.

509 Figure 2: Profile plot of time and gender interaction for work-life balance ($N = 116$).

510 Figure 3: Profile plot of time and gender interaction for job satisfaction ($N = 116$).

511 Figure 4: Profile plot of time and gender interaction for quality of life ($N = 116$).

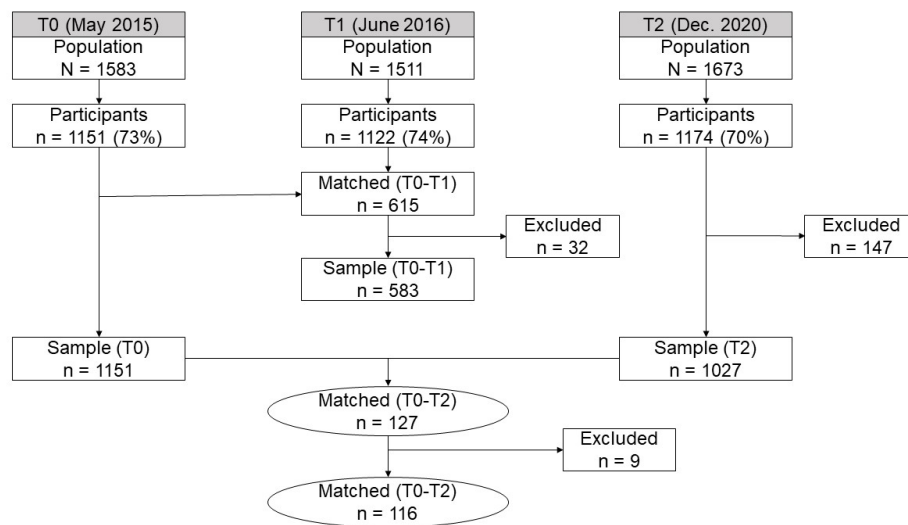


Figure 1: Participant flow chart across measurement points. Percentages in parentheses indicate response rates.

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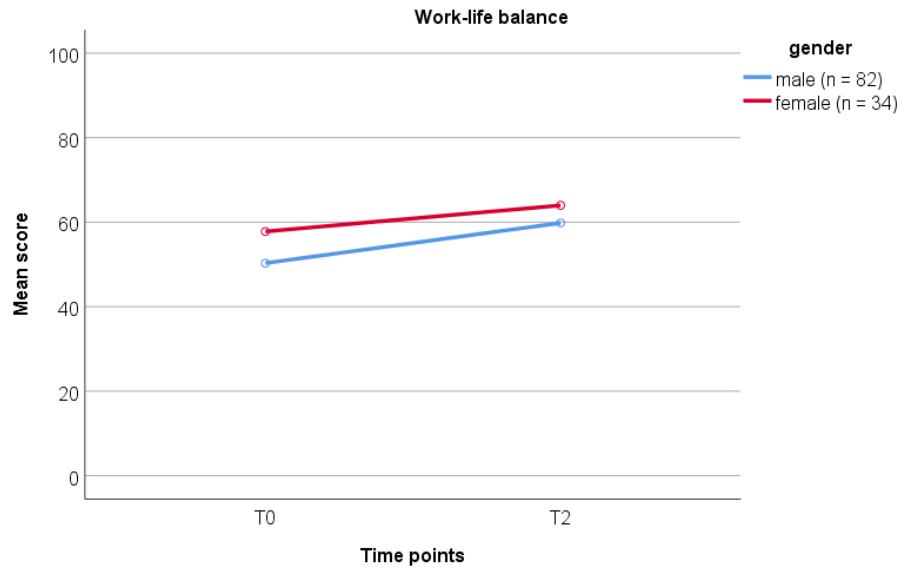


Figure 2. Profile plot of time and gender interaction for work-life balance (N = 116).

568x334mm (38 x 38 DPI)

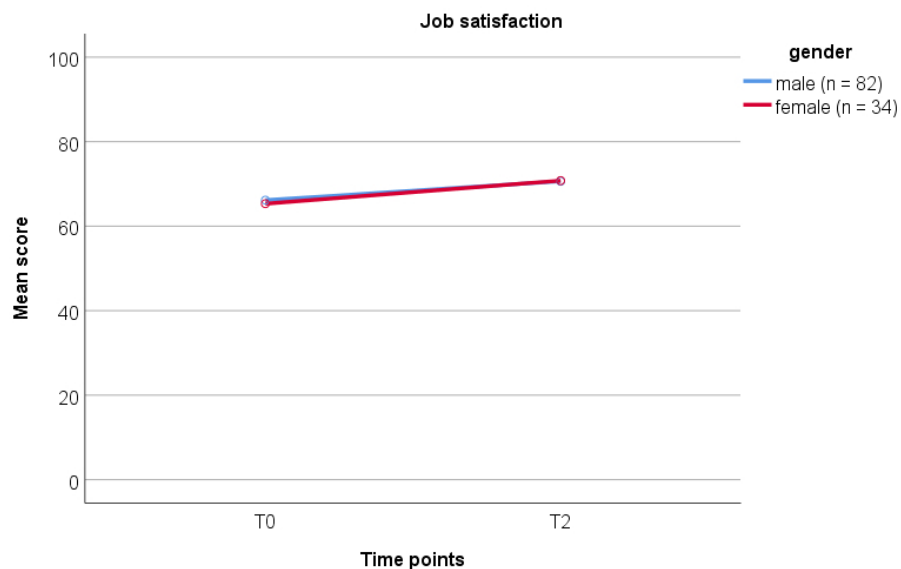


Figure 3. Profile plot of time and gender interaction for job satisfaction (N = 116).

568x334mm (38 x 38 DPI)

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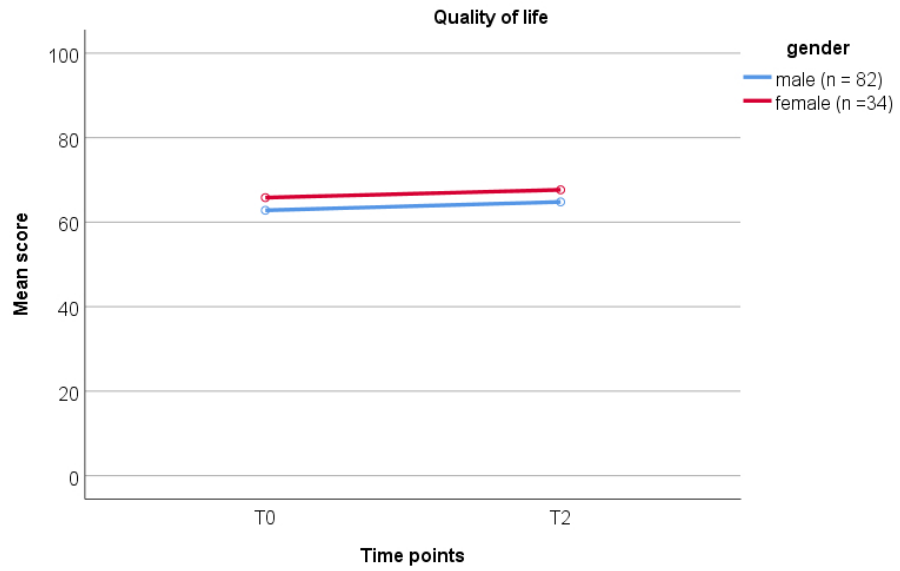


Figure 4. Profile plot of time and gender interaction for quality of life (N = 116).

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1 SUPPLEMENTARY MATERIALS

2 **Table S1. Comparison of previous and new shift schedule over an eight-week period.**

Recommendations	Previous shift schedule	New shift schedule
Number of consecutive night shifts (< 3)	1 night shift	2 night shifts
Rest period as long as possible after night shift phase (> 24h)	Yes	Yes
Blocked weekend breaks better than single days off	no free weekend	1 free weekend
Days off per rotation	2 days off (without "sleep-in days")	14 days off (without "sleep-in days")
Forward rotation better than backward rotation	Forward rotation	Forward rotation
Start early shift not before 6:00 a.m.	5:30 a.m.	6:00 a.m.
End night shift as early as possible	5:45 a.m.	6:00 a.m.
Flexibility for the individual worker	No	No
Avoid excessive daily working hours	4 x 12-hour shifts (Sundays only)	14 x 12-hour shifts
Further characteristics of shift schedules	including 40 hours for free shifts	including 39 hours for free shifts
	360 hours including duty instructions and sport	359 hours including duty instructions and sport
	40 duties	35 duties

3 *Note.* Recommendations based on German Social Accident Insurance (Paridon et al., 2012, p. 136)⁵².

4 Light grey indicates conformity, dark grey indicates non-conformity with recommendation.

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5 **Table S2. Means and standard deviations for work-life balance, job satisfaction and quality of life at all three points of measurement.**

Variables	T0 (N = 1151 ¹)				T1 (N = 1122 ²)				T2 (N = 1027 ³)			
	Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Work-life balance	.000	100.000	48.880	22.023	.000	100.000	52.805	23.967	.000	100.000	61.257	19.884
Job satisfaction	4.714	100.000	60.629	13.009	4.714	100.000	62.360	11.864	.000	100.000	69.439	12.372
Quality of life	.000	100.000	59.846	19.943	.000	100.000	64.436	19.451	.000	100.000	67.929	18.185

6 Note. ¹T0: Work-life balance *n* = 1121, job satisfaction *n* = 1108, quality of life *n* = 1149. ²T1: Work-life balance *n* = 1091, job satisfaction *n* = 1075, quality of life
7 *n* = 1117. ³T2: Work-life balance *n* = 1002, job satisfaction *n* = 989, quality of life *n* = 1020.

peer review only

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For peer review only

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, explain how loss to follow-up was addressed	5
		(e) Describe any sensitivity analyses	6
Results			6

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7-8
		(c) Summarise follow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Not applicable
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Police officers' work-life balance, job satisfaction and quality of life – Longitudinal effects after changing the shift schedule

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POLICE OFFICERS' WORK-LIFE BALANCE

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5 1 **POLICE OFFICERS' WORK-LIFE BALANCE, JOB**
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7 2 **SATISFACTION AND QUALITY OF LIFE – LONGITUDINAL**
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10 3 **EFFECTS AFTER CHANGING THE SHIFT SCHEDULE**
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13 4 Elisabeth Rohwer¹, Marcial Velasco Garrido¹, Robert Herold¹, Alexandra M. Preisser¹, Claudia
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POLICE OFFICERS' WORK-LIFE BALANCE

ABSTRACT

Objectives: To evaluate mental health-related outcomes of police officers five and a half years after implementing a new alternating shift schedule which was supposed to improve their health and work-life balance.

Design: Pre-post study design with a baseline survey at the beginning of the piloting of the new shift schedule in 2015 and another survey five and a half years later in 2020.

Setting: Police departments of a German metropolitan police force piloting the new shift schedule.

Participants: 116 shift-working police officers out of a population of 1673 police officers at the follow-up date.

Interventions: New shift schedule based on occupational health recommendations.

Outcomes measures: Work-life balance, job satisfaction and quality of life.

Methods: Mixed analyses of variances were used to test the hypotheses of within- and between-subject differences regarding time and gender.

Results: We found partly significant differences between the baseline and follow-up survey for work-life balance ($F(1, 114) = 6.168, p = .014, \eta_p^2 = .051$), job satisfaction ($F(1, 114) = 9.921, p = .002, \eta_p^2 = .080$) and quality of life ($F(1, 114) = .593, p = .443, \eta_p^2 = .005$). Neither significant differences between male and female police officers nor interaction effects of time and gender were found.

Conclusion: An increase was found for each of the three outcomes five and a half years after implementing the new shift schedule. The results contribute to the current state of research on mental health-related outcomes of working conditions in shift work. On this basis, recommendations for designing shift schedules can be deduced to promote mental health and job satisfaction for employees in shift work.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Changes in mental health-related outcomes among shift-working police officers were analysed using mixed analyses of variances to determine within- and between-subject differences before and after implementing a new shift schedule.
- The study was designed and conducted by an interdisciplinary team of psychologists, occupational physicians, health scientists and epidemiologists.
- The measurements were based on self-reports and thus may be subject to response bias.

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40 • Only a small proportion of the surveyed police officers could be matched over the measurement
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5 41 points, resulting in a reduced sample size and limited representativity of results.
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- Only a small proportion of the surveyed police officers could be matched over the measurement points, resulting in a reduced sample size and limited representativity of results.

For peer review only

INTRODUCTION

Police officers are exposed to various work-related demands in their jobs, with shift work being an inevitable one of them. Working in shifts, especially at night, is associated with several health risks, such as higher incidences of cardio-vascular diseases resulting from a disturbed circadian rhythm¹⁻³ and a potentially increased risk of cancer due to impaired melatonin secretion⁴⁻⁷. Furthermore, alternating shift work is associated with increased risk of sleep disturbances⁸, impaired mood and performance, and disrupted family and social relationships, which in turn can have a negative impact on physical and mental health⁹⁻¹³. Balancing work and leisure activities, such as partnership, family, caring for relatives, hobbies or voluntary work, thus poses a particular challenge for employees working in alternating shifts¹⁴. Similarly, job satisfaction is closely related to both physical and mental health¹⁵.

Particularly among shift-working police officers, prior research in the international context has focused on their sleep quality^{16,17}, work-related stress(ors)¹⁸⁻²⁰, trauma and associated suicidal ideation²¹⁻²³. The risk of suicide is substantially higher compared to other occupational groups²⁴. However, police officers' perceived work-related stress does not only result from their work content, but also results from their working conditions. For instance, irregular schedules, mandatory overtime and longer than 11-hour shifts have been associated with higher risk of burnout among police officers²⁵. Police officers' indispensable shift work is associated with sickness absence²⁶ and predicts work-family conflict²⁷. The latter also mediates between police officers' workload and job stress as well as job dissatisfaction²⁸. Apart from its association with higher levels of job dissatisfaction²⁹⁻³², police officers' work-life conflict is also related to burnout and stress³³⁻³⁵, more subjective health complaints and even suicidal ideation²⁷.

Although significant gender differences, in general, but especially among police officers who were married and/or had children, were found regarding psychosocial stress³⁶, further research findings highlight the significant relationship between stress and work-life balance³⁷ or work-family conflict^{38,39} affecting police officers regardless of their gender. Similarly, several studies indicate that gender does neither predict police officers' job satisfaction nor differ significantly between males and females⁴⁰⁻⁴², although contradictory results have been found^{43,44}. Literature also provides inconsistent findings on police officers' gender and perceived quality of life. A Greek study suggests that female and male police officers' scores do not differ significantly overall, but females reported lower levels of subscales of health-related quality of life which is – like job satisfaction – negatively associated with perceived stress. However, significant interactions were not revealed⁴⁴. Other studies have found no significant gender differences concerning police officers' quality of life⁴⁵. However, research on police officers' quality of life is only recently emerging^{46,47}.

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3 75 In this context, an evaluation at a German metropolitan police force revealed an improved work-life
4 76 balance among police officers after adapting the shift schedule according to occupational health
5 77 recommendations^{48 49}. Especially flexibility due to improved planning of free time and shorter shifts
6 78 were regarded as more compatible with family and leisure time activities⁴⁹. In a similar vein, a German
7 79 metropolitan police force aspired to adapt their alternating shift schedule and evaluate their newly-
8 80 developed shift schedule to improve their employees' health, work-life balance, job satisfaction and
9 81 general health. The shift schedule was thus changed from a four-week rotation with 35 to 49 hours of
10 82 work per week to an eight-week rhythm with 36 to 48 hours of work per week. The early duty week
11 83 with six consecutive early mornings, at 5:30 a.m. and one Sunday off was abolished. Previously
12 84 alternating day, late and night shifts, with 12.25 hours-day and night shifts in three subsequent weeks
13 85 and days off (so-called "sleep-in days") after night shifts following this early duty week were replaced
14 86 by two night shifts followed by two or three days off each week, resulting in at least one day off after
15 87 the "sleep-in day". In contrast to the previous shift schedule, the new system also stipulated
16 88 guaranteed days off without availability for special operations. 12-hour day and night shifts now
17 89 usually occurred twice a week, in some weeks only once. A comparison of both shift schedule models
18 90 regarding occupational health recommendations is provided in the supplementary materials' Table S1.

91 Objectives and hypotheses

92 As described above, the current state of research provides evidence that shift work can lead to work-
93 family conflicts and affect mental health and job satisfaction among police officers. However, there is
94 considerably less longitudinal research data demonstrating the effects of shift work systems on work-
95 and health-related outcomes. As part of a broader evaluation of the potential effects of the new shift
96 schedule on the working conditions at the metropolitan police, the aim of this study was to investigate
97 within-and between-subject psychological effects of the new shift schedule. Further results of
98 occupational health analyses⁵⁰ as well as analyses of sickness absence rates⁵¹ are presented in separate
99 articles. Within the evaluation process of the new shift schedule, we thus explored in the present study:
100 How does the newly introduced shift schedule impact police officers' work-life balance, job satisfaction
101 and quality of life? Is there a significant difference in work-life balance, job satisfaction and quality of
102 life at the two time points before and after implementing the new shift schedule or regarding their
103 gender?

104 Considering the state of research outlined above, we accordingly formulated the following hypotheses:

105 H_{1a}: Police officers' perceived work-life balance will be significantly higher rated five and a half years
106 after implementing the new shift schedule.

107 H_{1b}: There will be no significant main effect of gender on police officers' perceived work-life balance.

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108 H_{1c}: There will be no significant interaction effect of police officers' gender and time on their perceived
109 work-life balance.

110 H_{2a}: Police officers' job satisfaction will be significantly higher five and a half years after implementing
111 the new shift schedule.

112 H_{2b}: There will be no significant main effect of gender on police officers' job satisfaction.

113 H_{2c}: There will be no significant interaction effect of police officers' gender and time on their job
114 satisfaction.

115 H_{3a}: Police officers' perceived quality of life will be significantly higher five and a half years after
116 implementing the new shift schedule.

117 H_{3b}: There will be no significant main effect of gender on police officers' perceived quality of life.

118 H_{3c}: There will be no significant interaction effect of police officers' gender and time on their perceived
119 quality of life.

120 METHODS

121 Study design, population, and recruitment

122 The newly proposed shift schedule was piloted in a German metropolitan police force in a successive
123 roll-out across all police stations (PS). In May 2015, the first metropolitan PS introduced the new shift
124 schedule, followed by six other PS until the end of 2015. 16 further PS and the operations centre
125 introduced the new shift schedule until September 2017, one last PS changed their shift schedule in
126 the beginning of 2021. Data were collected at three time points using questionnaires. Only police
127 officers of four relevant duty groups who worked in the alternating shift schedule were included in the
128 study. Participating police officers worked at PS across the metropolitan area or the operations centre
129 where emergency calls are received and handled. The first survey took place shortly before the piloting
130 of the new rotating shift schedule started in May 2015 (T0), the second survey was conducted one year
131 later, in June 2016 (T1), followed by the third survey was scheduled exactly five years later in May 2020
132 but had to be postponed to December 2020 and early January 2021 due to the SARS-CoV-2 pandemic
133 (T2). Each time, standardised questionnaires with a covering letter were distributed via the official post
134 boxes to all police officers of the metropolitan police force working rotating shifts and belonging to the
135 predefined duty groups. Participants were asked to provide an individual matching code based on
136 digits and letters. The completed questionnaires could be placed anonymously in sealed ballot boxes
137 within four weeks. The paper questionnaires were then digitised with the data collection software
138 TeleForm® (Electric Paper Informationssysteme GmbH, Lüneburg, Germany). Despite the consistently
139 high response rates, owing to lack of consent, many retirements, and new recruitments of police
140 officers in the meantime, only 127 participants could be matched between T0 and T2. A further

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141 matching with T1-participants would have resulted in a sample size too small to analyse. Therefore,
142 only police officers participating in the baseline (T0) and follow-up (T2) surveys were matched. A
143 flowchart of this process is provided in Figure 1.

144 ---- insert Figure 1 here ----

145 Measures

146 Sociodemographic and job characteristics

147 We gathered information on participants' gender, age, rank within the police force, shift work
148 experience, type of employment and duty service, relationship status and number of children as well
149 as being a single parent or caring for relatives or others.

150 Work-life balance

151 Work-life balance was measured with five items which were already deployed and considered reliable
152 (Cronbach's $\alpha = .92$) in a similar survey of another German metropolitan police force⁴⁹. A sample item
153 was "The coordination of my daily work routine with my private matters works well." All items were
154 rated on a five-point Likert scale (1 = "I fully agree" to 5 = "I do not agree") and calculated as a score
155 ranging from 0 (worst work-life balance) to 100 (best possible work-life balance).

156 Job satisfaction

157 We measured job satisfaction with seven items of the German version of the Copenhagen Psychosocial
158 Questionnaire (COPSOQ) job satisfaction scale⁵². The items were presented on a four-point Likert scale,
159 ranging from 1 = "very satisfied" to 4 = "very unhappy". A sample item was "Regarding your work in
160 general. How pleased are you with your job as a whole, everything taken into consideration?" A score
161 was computed based on the items, ranging from 0 (lowest job satisfaction) to 100 (highest job
162 satisfaction). Both, the original and the latest COPSOQ study confirmed the German scale's validity and
163 reliability (Cronbach's α ranging from .79 to .82)^{52 53}.

164 Quality of life

165 Quality of life was assessed using two items of the World Health Organization's questionnaire
166 WHOQOL-Bref to calculate its global score ranging from 0 (worst quality of life) to 100 (best quality of
167 life)⁵⁴. Participants responded to the questions "Over the last two weeks, how would you rate your
168 quality of life?" and "Over the last two weeks, how satisfied were you with your health?" on a scale
169 from 1 = "very bad/unsatisfied" to 5 = "very good/satisfied". The instrument in its short version can be
170 considered reliable (Cronbach's α ranging from .57 to .88) and valid⁵⁴.

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171 Statistical analyses

172 After calculating the scores for work-life balance and job satisfaction, the data were tested regarding
173 the assumptions of a mixed analysis of variance (mixed ANOVA). After a check for missing values and
174 multivariate outliers, 11 cases were excluded, resulting in a final sample size of $N = 116$. Although most
175 of the normality tests (Kolmogorov-Smirnov and Shapiro-Wilk) indicated no normality of the data,
176 based on the sample size ($N = 116$, $n > 30$ for each group), normal Q-Q plots, skewness, and kurtosis
177 values (< 1.0), bivariate normal distribution of data could be assumed. The Pearson correlation matrix
178 further indicated no multicollinearity ($r < .63$). Box's test indicated homogeneity of covariance matrices
179 ($p > .05$) and Levene's tests indicated homoscedasticity ($p > .05$) in all mixed ANOVA. Mauchly's test
180 for sphericity was non-significant due to the analysis of two time points. Cohen's d was calculated from
181 η_p^2 and used to evaluate the effect sizes, considering $d = .20$ as a small effect, $d = .50$ as a medium
182 effect, and $d = .80$ as a large effect⁵⁵. In addition, mean scores and standard deviations were calculated
183 for each time point individually and a sensitivity analysis was conducted for the follow-up survey (T2)
184 to account for the different lengths of time police officers had worked with the new shift schedule (in
185 months) as a covariate. All statistical analyses were performed with IBM® SPSS® Statistics (version 25;
186 IBM Corp; Armonk, New York, USA), $p < 0.05$ was considered as significant.

187 Patient and Public involvement

188 Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of
189 our research.

190 Ethical considerations

191 The study was approved by the Ethics Review Committee of the Hamburg Medical Association,
192 Germany (PV4999 / WF-009/20). All participants provided informed consent for data collection after
193 receiving information on data protection and analysis. Participants who did not provide informed
194 consent were excluded from data analysis.

195 RESULTS

196 Participant characteristics

197 Most participants were male (70.7%). Most of the participating police officers were aged between 35
198 and 39 years (21.6 %; also median and modal age category) and worked in upper police service (65.5%).
199 Two thirds of them had already worked in shift work for more than ten years (66.4%). Almost 90%
200 worked fulltime and 68% had been predominantly on patrol duty in the past weeks before completing

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201 the survey. Participants also mostly lived in a permanent relationship (83.6%) and had at least one
 202 child (60.3%). Only less than 2% were single parents and slightly more (2.6%) cared for relatives or
 203 others alongside their job. Police officers' sociodemographic characteristics at baseline (T0) are
 204 provided in more detail in Table 1.

205 **Table 1. Sociodemographic characteristics of participants at baseline T0 (N = 116).**

Characteristics	<i>n</i>	%
Gender		
Male	82	70.7
Female	34	29.3
Age		
20-24 years	4	3.4
25-29 years	16	13.8
30-34 years	19	16.4
35-39 years	25	21.6
40-44 years	15	12.9
45-49 years	17	14.7
50-54 years	19	16.4
≥ 55 years	1	.9
Rank		
Intermediate police service	40	34.5
Upper police service	76	65.5
Shift work experience		
≤ 5 years	21	18.1
5-10 years	18	15.5
≥ 10 years	77	66.4
Type of employment		
Part-time	12	10.3
Fulltime	104	89.7
Type of duty service ¹		
Exclusively office duty	22	19.0
Predominantly office duty	8	6.9
Office and patrol duty (50:50)	7	6.0
Predominantly patrol duty	79	68.1
Permanent relationship		
Yes	97	83.6
No	18	15.5
No information given	1	.9
Children		
None	46	39.7
One child	20	17.2
Two children	35	30.2
Three children	12	10.3
Four children	3	2.6
Single parent		
Yes	2	1.7
No	100	86.2
No information given	14	12.1

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Caring for relatives/others		
Yes	3	2.6
No	113	97.4
Time working with the new shift schedule		
≤ 24 months	4	4.1
25-48 months	31	26.7
≥ 49 months	63	54.3
No information	18	15.5

206 *Note.* ¹Refers to type of service exercised in the last four weeks prior to taking the survey.

207 Descriptive statistics at all three time points indicated increasing mean scores with each survey. Work-
 208 life balance, job satisfaction and quality of life have been rated higher consecutively at each time point.
 209 For work-life balance and job satisfaction, the difference of means was greater over the longer period
 210 between T1 and T2 compared to T0 and T1. For quality of life, by contrast, the difference was greater
 211 between T0 and T1, whereas between T1 and T2 only a smaller difference of the mean could be
 212 observed, as displayed in Table S2 in the supplementary material.

213 Within-subjects effects of time

214 The descriptive cross-sectional findings of each measurement point were also found in the matched
 215 sample of baseline and follow-up mean scores we used for the principal analyses. Means of all three
 216 dependent variables were higher at T2 than at T0 (see Table 2). The mixed ANOVA revealed significant
 217 small and medium-sized main effects for the within-subjects effects on police officers' work-life
 218 balance ($F(1, 114) = 6.168, p = .014, \eta_p^2 = .051, d = .464$) and job satisfaction ($F(1, 114) = 9.921, p = .002,$
 219 $\eta_p^2 = .080, d = .590$), thereby confirming hypotheses H_{1a} and H_{2a} . The main effect for quality of life was
 220 not significant ($F(1, 114) = .593, p = .443, \eta_p^2 = .005$). Hypothesis H_{3a} thus had to be rejected.

221 **Table 2. Means and standard deviations for work-life balance, job satisfaction and quality of life (N**
 222 **= 116).**

		Work-life balance		Job satisfaction		Quality of life	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
T0	Males ¹	50.305	21.305	66.148	11.538	62.805	17.675
	Females ²	57.794	22.670	65.314	10.308	65.809	19.294
	Total	52.500	21.884	65.904	11.153	63.685	18.131
T2	Males ¹	59.817	24.145	70.635	12.637	64.787	18.750
	Females ²	63.971	21.098	70.777	12.370	67.647	22.638
	Total	61.034	23.280	70.677	12.506	65.625	19.910

223 *Note.* ¹ $n = 82.$ ² $n = 34.$

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224 **Between-subjects effects of gender and interactions**

225 Regarding the between-subjects effects, the mixed ANOVA showed that no significant main effect of
226 gender ($F(1,114) = 3.046, p = .084, \eta_p^2 = .026$) on perceived work-life balance. While female police
227 officers' mean rating increased by six points, their male colleagues' mean rating increased by almost
228 ten points from T0 to T2 (see Table 2), the difference was not significant and both groups showed the
229 same pattern. Therefore, no significant interaction between time and gender ($F(1,114) = .279, p = .598,$
230 $\eta_p^2 = .002$) was found. Figure 2 illustrates that both, males and females showed a similarly sized
231 increase for work-life balance across time. These findings support our hypotheses H_{1b-c} .

232 Likewise, no significant difference was found between male and female police officers with regard to
233 their job satisfaction ($F(1,114) = .035, p = .851, \eta_p^2 = .000$), supporting hypothesis H_{2b} . Female and male
234 participants' mean job satisfaction increased comparably from T0 to T2 (see Table 2). However, women
235 reported marginally higher values at T2 (+.142 points compared to their male colleagues). Therefore,
236 the profile plot in Figure 3 depicts slightly crossing lines. Nevertheless, in support of hypothesis H_{2c} , no
237 significant interaction between time and gender ($F(1,114) = .095, p = .758, \eta_p^2 = .001$) was found for
238 job satisfaction either.

239 In line with hypothesis H_{3b} , we found no significant differences in quality of life means between males
240 and females ($F(1,114) = .956, p = .330, \eta_p^2 = .008$). Female police officers rated their quality of life higher
241 than their male colleagues at both time points but both means increased at the same rate (see Table
242 2). Therefore, no interaction between time and gender was found ($F(1,114) = .001, p = .977, \eta_p^2 = .000$),
243 as assumed in hypothesis H_{3c} and depicted in Figure 4.

244 ---- insert Figures 2-4 here ----

245 Sensitivity analyses with data from the follow up-survey (T2, $n = 893$ for work-life balance, $n = 881$ for
246 job satisfaction and $n = 907$ for quality of life) indicated that when controlling for the length of time
247 police officers had worked according to the new shift schedule, between-subject differences did not
248 change and remained insignificant regardless of whether the exposure duration was added to the
249 model or not.

250 **DISCUSSION**

251 In the present study, we analysed within- and between-subject differences of three work-related
252 mental health outcomes among police officers of a German metropolitan police department at two
253 time points. The baseline data were compared to the survey results five and a half years later, after
254 implementing a new shift schedule which was supposed to improve mental and physical health of the

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3 255 police officers. Our findings provide support for most of our hypotheses: work-life balance and job
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5 256 satisfaction scores significantly increased between the baseline survey and the follow-up. Quality of
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7 257 life increased as well, but not to a statistically significant extent. At both time points, female police
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9 258 officers reported higher levels of work-life balance and quality of life, whereas male participants rated
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11 259 their job satisfaction higher at the baseline. However, no significant differences were found between
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13 260 male and female police officers regarding their work-life balance, job satisfaction and quality of life.
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15 261 Notably, the greatest increase over the five and a half years could be observed in the work-life balance
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17 262 of police officers, followed by job satisfaction and quality of life.

17 263 Consistent with previous findings, restricted work-life balance due to the shift schedule affected male
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19 264 and female police officers equally³⁷⁻³⁹. Sociodemographic characteristics revealed that most of the
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21 265 participants had children and lived in a permanent relationship, whereas only very few participants
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23 266 were single parents. This may indicate that parents shared their care for children or other relatives and
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25 267 that traditional gender roles are being undone³⁷. However, work-life balance does not only include
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27 268 balancing work and family matters but also social life and leisure activities. Our results are further
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29 269 supported by findings of a another German metropolitan police force that evaluated similar shift
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31 270 schedules which served as a blueprint for the one we evaluated^{48 49}. Accordingly, shift schedules with
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33 271 more flexible working time arrangements reduced the impact of work-life balance as a potential
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35 272 stressor and that work-life balance was negatively related to police officers' perceived strain⁴⁸.

35 273 At both time points, job satisfaction means exceeded those reported by the international and German
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37 274 general working population^{53 56}, indicating a high job satisfaction among our participants overall. In line
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39 275 with our results, recent findings suggest that changing the shift schedule could have a positive
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41 276 influence on police officers' job satisfaction⁵⁷. In partial contradiction with our findings, male police
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43 277 officers reported lower job satisfaction compared to female colleagues in a Greek sample, while female
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45 278 police officers reported lower values of health-related quality of life compared to their male
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47 279 colleagues⁴⁴. However, the slightly greater increase of job satisfaction ratings among female
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49 280 participants in our sample could indicate a gradually closing gender gap with the new shift schedule in
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51 281 this regard. Yet the results need to be interpreted very cautiously and need to be further evaluated in
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53 282 the long-term, as the differences were small and not significant.

52 283 Compared to norm values, quality of life was rated lower in our sample at both time points⁵⁴. A cross-
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54 284 sectional study among criminal police officers also revealed lower health-related quality of life scores
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56 285 compared to results from general populations⁴⁶. Nevertheless, it becomes apparent that the quality of
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58 286 life marginally increased after implementing the new shift schedule, although to a non-significant and
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60 287 lesser extent than work-life balance and job satisfaction. Further analyses indicated that the working
60 288 conditions of the new shift schedule, especially the increased number of 12-hour shifts, did not have

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289 a detrimental impact on the police officers' quality of life⁵⁰. Why the scores for work-life balance and
290 job satisfaction but not for quality of life between males and females seem to align over time thus
291 remains unclear. As research on police officers' quality of life has been unfolding recently, future
292 research will hopefully provide more insights on such differences and further associations.

293 Limitations

294 Based on longitudinal data, we were able to examine changes in health-related outcomes among shift-
295 working police officers before and after implementing a new shift schedule and thus contributed to a
296 deeper understanding of these outcomes associated with working conditions in shift schedules.
297 However, some limitations need to be discussed. Although we were able to gather and analyse data
298 over three different time points, we could only evaluate the baseline and follow-up data in a
299 longitudinal design. Despite high response rates, lack of given consent to evaluate the data,
300 retirements and new recruits led to an insufficient sample size after matching participants across all
301 three time points. Since the piloting was carried out as a successive rollout, not all of the PS surveyed
302 had introduced the new shift schedule or had sufficient experience with the new shift schedule after
303 one year (T1). We therefore dropped the data of the second evaluation for longitudinal analyses to
304 present longer-term rather than short-term effects. Information on short-term changes one year after
305 the baseline (i.e. piloting of the new shift schedule) are therefore not included in the present analyses.
306 Due to the small sample size, we did not include the exposure duration of the new shift schedule as a
307 covariate into the primary analysis. However, sensitivity analyses conducted on the larger data set of
308 the cross-sectional data from the follow-up survey (T2) showed that the effects did not change when
309 the covariate was added to the model. Neither did age have a significant effect, according to further
310 analyses. Although we were able to analyse a larger sample size by considering the baseline and follow-
311 up only, the matched sample differs from the population of shift-working police officers at T2 in age
312 and gender and is therefore not representative of the current metropolitan police force which is now
313 younger and includes more female police officers⁵⁰, again due to retirements and new recruitments.
314 The results from this sample might also not necessarily valid for other police forces. Moreover, the
315 analysed data stem from self-reports of the participants and are thus susceptible to bias such as socially
316 desirable answers. Motivational efforts may also have had an effect on the participants' responses, as
317 the results of the evaluation served as a decision-making basis on the continuation of the piloted shift
318 schedule. Furthermore, selection effects such as the healthy worker effect may influence the results.
319 Answers from colleagues who were under a lot of strain, ill or not able to work, who retired early or
320 changed their profession may have not been reflected in the results which may therefore appear more
321 positive than they would be based on the whole relevant police work force. Lastly, merely effects up
322 to five and a half years after implementing the new shift schedule became evident in this study. Longer-

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323 term effects will have to be further evaluated in the future to be able to assess the new shift schedule
324 in this respect.

325 Implications for research and practice

326 Our results provide evidence that changing a shift schedule according to occupational health
327 recommendations improved police officers work-life balance and job satisfaction. Nevertheless, it
328 must be taken into account that according to German labour legislation the implementation of 12-
329 hour duties, which is implemented based on European law, requires special permissions and should
330 be strictly limited to the minimum necessary to cover the service. Working in shifts or at nonstandard
331 hours interferes with leisure time and can thus restrict social life or even parenting functioning
332 resources^{14 58}. The costs and benefits of longer duties and consecutive off-duty periods therefore must
333 be weighed carefully. For a better work-life balance and prevention of detrimental health effects, shifts
334 should be variable and predictable^{14 48 59}. This was implemented with the new shift schedule and
335 acknowledged in additional free text answers participants gave in the follow-up survey. To better
336 balance police work with care work that occurs in specific stages of life, such as raising children or
337 caring for relatives, more flexible working time models could be supportive. In relation to the entire
338 working life, working time could be reduced in such phases, therefore enabling a better balance of
339 private and professional life⁴⁸. After successfully implementing the new shift schedule, further health-
340 promoting measures should be offered to police officers. Research findings suggest that educational-
341 based family-friendly programmes should be established in PS⁶⁰. Moreover, several health promotion
342 programmes for police forces have been evaluated recently⁶¹⁻⁶³. At least in online trainings, it seems
343 to be harder to change mental health and attitudes toward suicide compared to knowledge and
344 competence, as an intervention study among German-speaking police officers implies⁶⁴. In this vein,
345 mindfulness-based health promotion was recently shown to be feasible and efficacious to improve
346 quality of life among Brazilian officers⁶¹. It is also recommended to identify police officers' risk factors
347 for mental health early to be able to prevent and promote their quality of life⁶⁵. Job control and a
348 flexibility-oriented culture can positively influence job satisfaction⁶⁶. Continuous participation of police
349 officers should be maintained to shape and continuously adapt the change process of implementing
350 the new shift schedule⁴⁸. Regularly conducted risk assessments can provide a basis for this and identify
351 such stressors to counteract them preventively.

352 CONCLUSION

353 The results of this longitudinal study demonstrated small positive changes five and a half years after
354 adapting a German metropolitan police force's alternating shift schedule. The new shift schedule
355 providing more 12-hour shifts as well as more off-duty days enabled police officers to better balance

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private and work-related demands regardless of their gender. The altered working conditions were also reflected in higher job satisfaction, whereas the increase in quality of life was not significant. Despite the benefits of more predictable scheduling and free time in the new shift schedule, more frequent 12-hour shifts during the day and night may entail adverse health effects in the long run. Therefore, larger cohort studies and evaluations over a longer period with several measurement points are recommended to verify the effects and continuously monitor its consequences for police officers.

STATEMENTS

Dedication: We respectfully dedicate this paper to the memory of our colleague Cordula Bittner (1968-2019), who led the first part of the evaluation (2015-2016) ensuring a fruitful dialogue between researchers and police, which laid the foundation for the further evaluation 2021.

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Authors' contributions: ER drafted the manuscript and conducted data analyses. ER, MVG and RH prepared the data for analyses. ER, MVG, RH, AMP, CT, VH and SM participated in designing the study. MVG, RH, AMP, CT, VH and SM supervised the study and data analyses. MVG administered the project. MVG, RH, AMP, CT, VH and SM contributed in the drafting of the manuscript. All authors read and approved the final manuscript.

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FIGURE LEGENDS

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21 555 Figure 1: Participant flow chart across measurement points. Percentages in parentheses indicate
22 556 response rates.
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24 557 Figure 2: Profile plot of time and gender interaction for work-life balance ($N = 116$).
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26 558 Figure 3: Profile plot of time and gender interaction for job satisfaction ($N = 116$).
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28 559 Figure 4: Profile plot of time and gender interaction for quality of life ($N = 116$).
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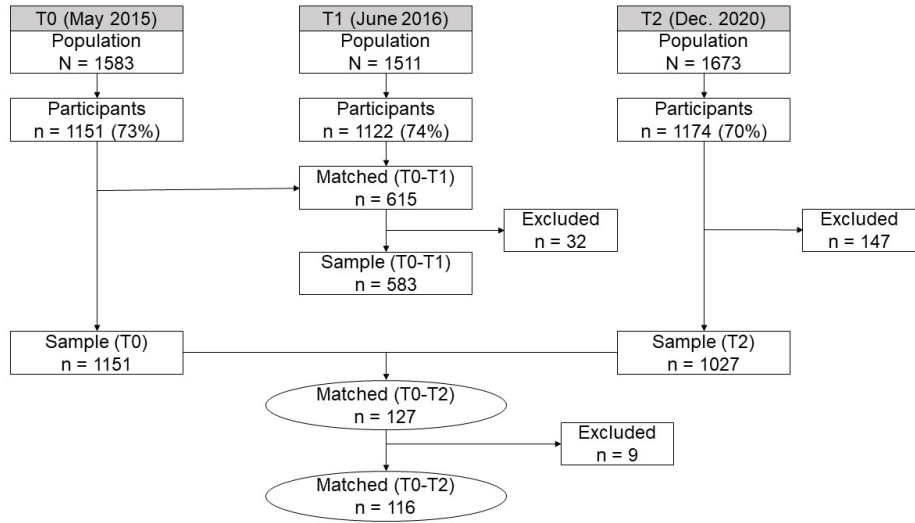


Figure 1: Participant flow chart across measurement points. Percentages in parentheses indicate response rates.

338x190mm (96 x 96 DPI)

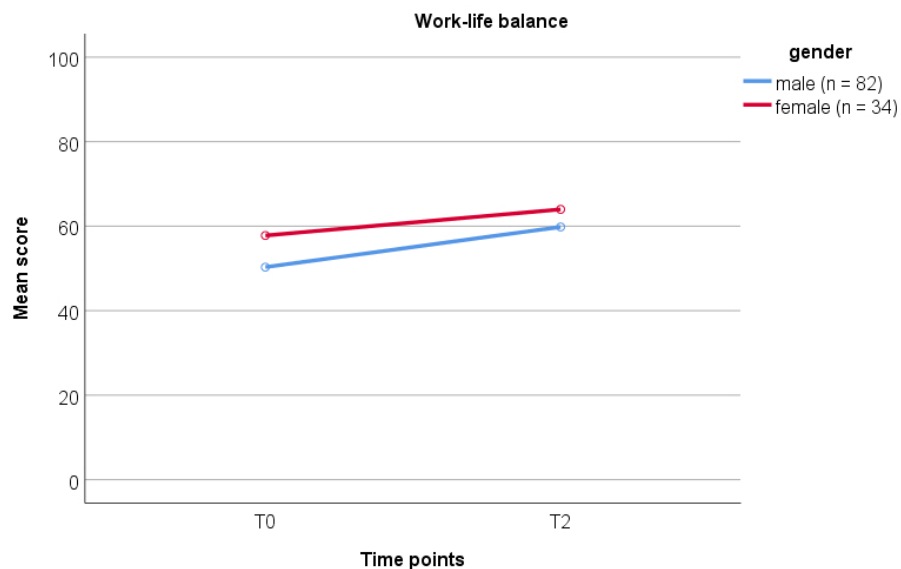


Figure 2. Profile plot of time and gender interaction for work-life balance (N = 116).

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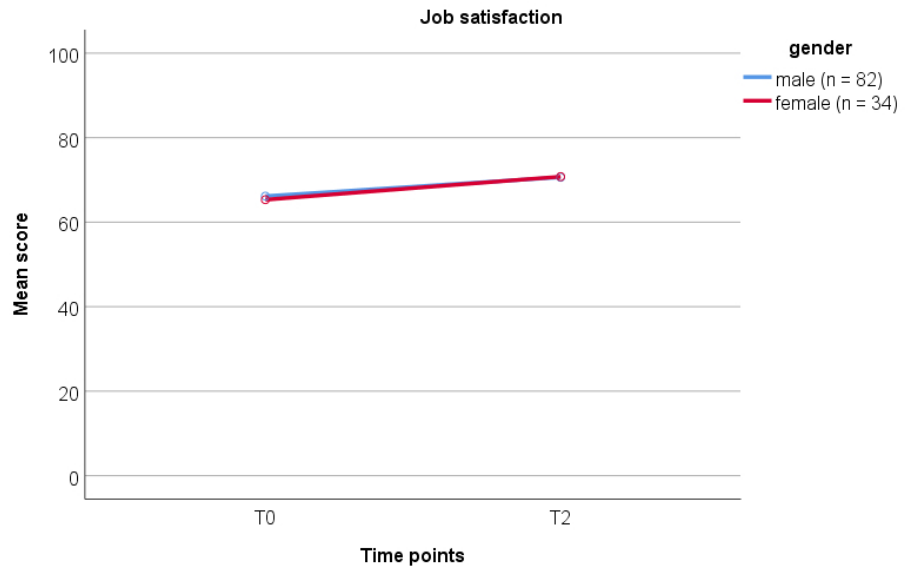


Figure 3. Profile plot of time and gender interaction for job satisfaction (N = 116).

568x334mm (38 x 38 DPI)

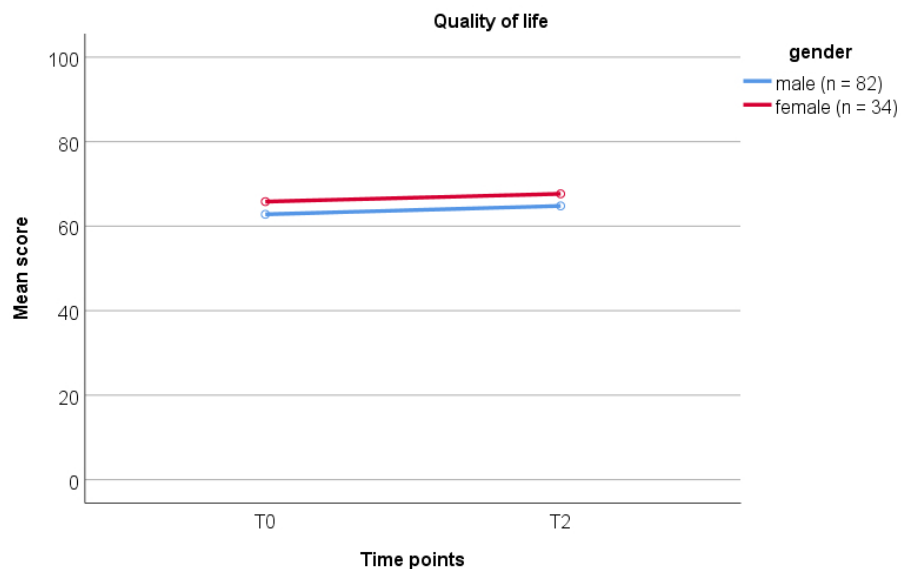


Figure 4. Profile plot of time and gender interaction for quality of life (N = 116).

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POLICE OFFICERS' WORK-LIFE BALANCE

1 SUPPLEMENTARY MATERIALS

2 **Table S1. Comparison of previous and new shift schedule over an eight-week period.**

Recommendations	Previous shift schedule	New shift schedule
Number of consecutive night shifts (< 3)	1 night shift	2 night shifts
Rest period as long as possible after night shift phase (> 24h)	Yes	Yes
Blocked weekend breaks better than single days off	no free weekend	1 free weekend
Days off per rotation	2 days off (without "sleep-in days")	14 days off (without "sleep-in days")
Forward rotation better than backward rotation	Forward rotation	Forward rotation
Start early shift not before 6:00 a.m.	5:30 a.m.	6:00 a.m.
End night shift as early as possible	5:45 a.m.	6:00 a.m.
Flexibility for the individual worker	No	No
Avoid excessive daily working hours	4 x 12-hour shifts (Sundays only)	14 x 12-hour shifts
Further characteristics of shift schedules	including 40 hours for free shifts	including 39 hours for free shifts
	360 hours including duty instructions and sport	359 hours including duty instructions and sport
	40 duties	35 duties

3 *Note.* Recommendations based on German Social Accident Insurance (Paridon et al., 2012, p. 136)¹.

4 Light grey indicates conformity, dark grey indicates non-conformity with recommendation.

POLICE OFFICERS' WORK-LIFE BALANCE

5 **Table S2. Means and standard deviations for work-life balance, job satisfaction and quality of life at all three points of measurement.**

Variables	T0 (N = 1151 ¹)				T1 (N = 1122 ²)				T2 (N = 1027 ³)			
	Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Work-life balance	.000	100.000	48.880	22.023	.000	100.000	52.805	23.967	.000	100.000	61.257	19.884
Job satisfaction	4.714	100.000	60.629	13.009	4.714	100.000	62.360	11.864	.000	100.000	69.439	12.372
Quality of life	.000	100.000	59.846	19.943	.000	100.000	64.436	19.451	.000	100.000	67.929	18.185

6 Note. ¹T0: Work-life balance $n = 1121$, job satisfaction $n = 1108$, quality of life $n = 1149$. ²T1: Work-life balance $n = 1091$, job satisfaction $n = 1075$, quality of life
7 $n = 1117$. ³T2: Work-life balance $n = 1002$, job satisfaction $n = 989$, quality of life $n = 102$

POLICE OFFICERS' WORK-LIFE BALANCE

8 References

9 1. Paridon H, Ernst S, Harth V, et al. DGUV Report 1/2012: Schichtarbeit. Rechtslage, gesundheitliche
10 Risiken und Präventionsmöglichkeiten [DGUV Report 1/2012: Shift work. Legal situation,
11 health risks and prevention options] Berlin: Deutsche Gesetzliche Unfallversicherung (DGUV);
12 2012 [Available from: <https://publikationen.dguv.de/widgets/pdf/download/article/2554>
13 accessed 8 February 2022].

For peer review only

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	<u>21</u>
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	<u>22</u>
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	<u>109</u>
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	<u>6-7</u>
		(b) Describe any methods used to examine subgroups and interactions	<u>6-7</u>
		(c) Explain how missing data were addressed	6
		(d) If applicable, explain how loss to follow-up was addressed	5
		(e) Describe any sensitivity analyses	6
Results			<u>106</u>

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
		(c) Summarise follow-up time (eg, average and total amount)	98
Outcome data	15*	Report numbers of outcome events or summary measures over time	98
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Not applicable
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12 1
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	146

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.