

A mixed-method study on job satisfaction among air traffic controllers during the pandemic: the roles of work-family interface and resilience

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Disclosure Statement: No potential conflict of interest was reported by the author(s).

Funding: The authors did not receive a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Abstract

Objective: to investigate whether workload is negatively related to job satisfaction, directly and indirectly, via work-family conflict, and conditional on resilience levels.

Background: Covid-19 restriction measures severely affected the aviation sector leading air traffic controllers to face periodic fluctuations in air traffic volume. Despite their key role in ensuring the efficiency and safety of air traffic management, little is known about the psychological issues faced by air traffic controllers during the pandemic.

Method: A total of 168 Italian air traffic controllers completed an online self-report survey assessing workload, work-family conflict, job satisfaction, resilience, and Covid-19-related experience. Descriptive statistics and moderated mediation analyses were performed. To deepen the quantitative results, ten semi-structured interviews were conducted, and were analysed using thematic analysis.

Results: Workload was positively related to work-family conflict which, in turn, was negatively associated with job satisfaction. Resilience buffered this association. The following six main themes emerged from the interviews: the impact of the Covid-19 pandemic; double-edged job characteristics; job-related risks stressors; protective resources; work-life interface; and consequences.

Conclusion: Air traffic controllers who were confronted with sudden increases in air traffic volume were more likely to experience work-family conflict and then be less satisfied with their job. However, resilience was a protective factor against lower job satisfaction under high work-family conflict levels. Qualitative results deepened these findings. The practical implications of these findings are discussed.

Keywords: Workload; Work-family interface; Job satisfaction; Resilience; Mixed-method study

Introduction

During the Covid-19 pandemic, the aviation sector was severely affected by travel restrictions and measures to contain transmission. As such, the International Air Transport Association (IATA) referred to the COVID-19 pandemic as “the largest shock to commercial air travel and aviation since World War II” (IATA, 2020). In October 2020, there was a 62% decrease in the total number of commercial flights in the European Union compared with the same month in 2019 (Eurostat, 2021). For instance, Italy (the country where this study was conducted), which was the first European country to be hit by the virus and the second in terms of Covid-19 deaths (after the UK), registered a 97% decrease in air traffic volume in April 2020 compared with the same month in 2019. Air traffic recovered somewhat during the summer of 2020 and then started slowly declining in September through October 2020 (Eurocontrol, 2020). Italy reported 700,000 flights and 112 million passengers lost during this period, placing it fifth in Europe in terms of traffic loss (Eurocontrol, 2020). Yet, the air transport industry slowly recovered throughout 2021, witnessing the closest return to pre-pandemic figures since October 2021 (-30%; Eurostat, 2021). These variations in traffic volume, together with the adoption of Covid-19 containment measures in the workplace, profoundly impacted the daily work activities of air traffic controllers (ATCOs). Although there is evidence that pandemic-related job demands caused a major disruption to job satisfaction of military and airline pilots (Kiouleoglou & Blundell, 2022), less is known about how workload perceived by ATCOs during the pandemic affected their job satisfaction, with no previous studies conducted on this topic on Italian ATCOs. Filling this gap is of utmost importance because job dissatisfaction is a threat to ATCOs’ productivity (Qureshi et al., 2019) and team cooperation (Kuang et al., 2020), which may increase the risk of jeopardizing the efficiency and safety of air traffic management (Kuang

et al., 2020). Therefore, this study aims to investigate *how* and *when* workload can be negatively related to job satisfaction among Italian ATCOs during pandemic times.

Workload and job satisfaction

Existing studies on ATCOs indicate that during normal times they work under great time pressure and have high responsibilities for the safe flight of passengers and crews (Triyanti et al., 2020). Additionally, ATCOs have to devote considerable mental energies to handle complex and multiple tasks that require them to focus on the present moment, while remaining prepared to shift their attention between tasks (Bongo & Seva, 2022; Cascino & Mélan, 2019; Makara-Studzińska et al., 2021). As a result, workload (i.e., the amount of work that has to be done by a specific person at a specific time; Liu & Lo, 2018) has been identified as one of the main causes of job stress among ATCOs (Triyanti et al., 2020). Indeed, the excessive workload may negatively affect ATCOs' work-related outcomes, including job performance (Edwards et al., 2016) and job satisfaction (Jou et al., 2013). Although the relationship between workload and job satisfaction (i.e., a pleasurable emotional state arising from the appraisal of one's job; Locke, 1976) has been extensively studied in other sectors, albeit showing inconsistent results (Liu & Lo, 2018; Inegbedion et al., 2020), little is known about this association among ATCOs. One of the few studies examining the workload-job satisfaction relationship on a sample of Taiwan ATCOs found that workload was a source of job stress negatively affecting ATCOs' job satisfaction (Jou et al., 2013). Therefore, we expect that workload will be negatively associated with job satisfaction (*H_p 1*).

The mediating role of work-family conflict in the workload-job satisfaction relationship

A mechanism explaining how workload may be link to ATCOs' job satisfaction may be work-family conflict (WFC; i.e., incompatible demands arising from work and family domains with consequent difficulty in addressing them simultaneously; Bernuzzi et al., 2022) because this form of conflict has been identified as one of the main job stressors experienced by ATCOs

(Jou et al., 2013). This job stressor may result from specific characteristics of their job (e.g., nightshifts), including workload (Repetti, 1989). Although the positive association between workload and WFC is well-known (e.g., De Carlo et al., 2019), little empirical research on this relationship has been done in the air traffic control context. An exception is represented by Repetti's study (1989) showing that objective and subjective indicators of workload (e.g., traffic volume, busyness) were positively related to marital withdrawal and expression of marital anger. This is in accordance with the spillover theories asserting that how people behave and feel at work may spill over into the family domain (Edwards & Rothbard, 2000). Studying WFC is relevant because ATCOs who experience WFC are more likely to develop turnover tendencies and job dissatisfaction (Jou et al., 2013). However, as far as we know, there is only one study demonstrating that WFC is a predictor of job dissatisfaction among ATCOs (Jou et al., 2013). Additionally, there are no studies analysing the mediating role of WFC in the workload-job satisfaction link among ATCOs during normal or pandemic times. Nevertheless, in a relatively similar context, Baeriswyl and colleagues (2016) showed that airport security officers who faced considerable workload were more likely to report WFC which, in turn, decreased their professional satisfaction. This may be explained in light of Conservation of Resources (COR) theory (Hobfoll et al., 2018). Drawing on this theory, ATCOs may have to devote considerable time, mental and physical energies (i.e., resources) to handle complex and multiple job-related tasks, which may leave them with fewer resources to invest in the family domain, resulting in WFC. In such a situation, ATCOs have to invest additional resources to manage conflicting inter-role demands, losing further resources. This may elicit a negative state of being and lead ATCOs to perceive their working condition as a threat to other self-relevant roles (i.e., parent, partner). As a result, they may appraise the source of the conflict (i.e., job) negatively and reduce their motivation to engage in their job to protect their remaining resources, experiencing lower job satisfaction levels (Grandey et al., 2005; Hobfoll et al., 2018;

Lazarus & Folkman, 1984). Taking into account these empirical findings and the above theoretical reasoning, we expect that workload will be positively related to WFC (*H_p 2*) which, in turn, will be negatively associated with job satisfaction (*H_p 3*).

The protective role of resilience

Drawing on COR theory (Hobfoll et al., 2018), individuals can react to the same stressor differently depending on their personal resource levels (Hobfoll et al., 2018). Among personal resources, resilience (i.e., a dynamic process that allows individuals to rebound and recover from adversities; Bernuzzi et al., 2022) seems to be particularly relevant because it helps individuals cope with job-related stressors, protecting them against WFC (Sommovigo et al., 2023). However, as far as we know, no study has analysed the moderating role of resilience in the relationship between workload and job satisfaction through WFC in a sample of ATCOs. Indeed, most previous aviation studies have focused on resilience at the organizational or system levels (e.g., Xu & Zhang, 2022), while less attention has been given to workplace resilience at the individual level regarding human factors in aviation (Douglas & Pittenger, 2020). Nevertheless, resilience may allow ATCOs to effectively mobilize their available resources to successfully handle workload (Hobfoll & Shirom, 2001). In this view, highly resilient ATCOs are better equipped to recover from setbacks at work, see challenging work-related conditions as an opportunity to grow (rather than a threat), and better manage job demands because of their capability to learn from their mistakes (Youssef & Luthans, 2007). Thus, since ATCOs with high resilience can manage well and perceive work-related difficulties as opportunities to learn, they should be especially motivated to exploit their personal energy to combine work and family requirements, becoming less vulnerable to WFC. Overall, the above reasoning suggests that the effects of workload on WFC and then job satisfaction will be weaker for ATCOs with high (vs. low) resilience (*H_p 4*).

Figure 1 depicts our conceptual model for the quantitative part of this study. To reach a more in-depth understanding of these relationships, we integrated quantitative data with qualitative data from interviews conducted on ATCOs. In doing so, this mixed-method study contributes to the literature on ATCOs in several ways. By analysing WFC as a mechanism linking workload to job satisfaction among ATCOs, this study answers calls for more research on the workload-job satisfaction link (Inegbedion et al., 2020). Moreover, our qualitative data allowed us to identify which specific characteristics of ATCOs' activities could affect their family life, thus shedding light on the still understudied topic of WFC among ATCOs (Öge et al., 2018). Additionally, using a combination of qualitative and quantitative data enabled us to enhance the integrity of our findings (Bryman, 2006) and provide an in-depth overview of the experiences of Italian ATCOs during the Covid-19 pandemic. Finally, since resilience is malleable through proper training (Joyce et al., 2018), analysing its protective role can inform practitioners on how to prevent WFC among ATCOs during difficult times.

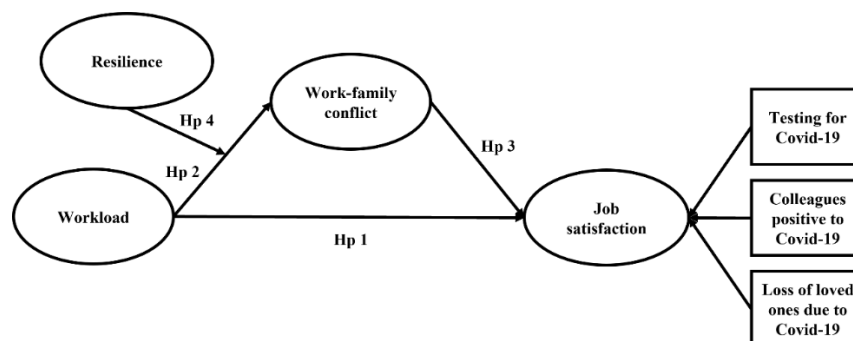


Figure 1. Conceptual model.

Ethical Approval

This research project was approved by the Ethics Committee of the University of XXX.

Quantitative survey

Materials and methods

Participants and Procedure

The target population of this cross-sectional study was composed of ATCOs working throughout the national territory of Italy. Sending newsletters to all members of the Italian National Association of Assistants and Air Traffic Controllers, the general secretary of the association invited 400 ATCOs to join an online research survey. The questionnaire's cover sheet informed respondents about the study's goals and ensured both the voluntariness of their participation and the anonymity of the responses. After providing their informed consent, a total of 170 ATCOs (response rate: 42.5%) completed questionnaires using Google Forms. Among these, two respondents were removed because they did not answer at least the 60% of the survey, reducing the sample size from 170 to 168. Participants took approximately 20 minutes to complete the survey. ATCOs answered questions regarding their perceptions of workload, WFC, job satisfaction, and resilience. Only a few socio-demographic characteristics were collected to further guarantee anonymity. Because the data were collected between October and November 2020, participants were invited to provide some information on their direct and vicarious experience with COVID-19. The sample was mainly composed of men (88.60%) with an average age of 44.76 ($SD=7.86$) years and average job tenure of 15.54 ($SD=8.49$) years (see *Table 1*).

Table 1. Descriptive statistics regarding the sample and the Covid-19-related variables ($N=168$).

| | <i>%(n)</i> |
|---|-------------|
| Have you been tested for Covid-19? | |
| Yes | 31.10 (52) |
| Have you been diagnosed with Covid-19? | |
| Yes | 1.80 (3) |
| Have any of your colleagues been diagnosed with Covid-19? | |
| Yes | 68.10 (113) |
| Have any of your loved ones among the most vulnerable to Covid-19? | |

| | |
|---|--------------|
| Yes | 77.80 (130) |
| Have any of your loved ones been among the fatalities? | |
| Yes | 5.40 (9) |
| Gender | |
| Male | 88.60 (148) |
| <hr/> | |
| <i>M(SD)</i> | |
| <hr/> | |
| Age | 44.76 (7.86) |
| Job tenure | 15.54 (8.49) |
| <hr/> | |

Note. M = Mean; SD = Standard Deviation.

Measures

Since the sample was composed of Italian ATCOs, the survey was administered in Italian. Participants were asked to complete the questionnaire considering the period since the beginning of the Covid-19 pandemic.

Workload was measured with the three-item Workload Scale (Jou et al., 2013) which was translated into Italian through a backward and forward translation process. Participants indicated the degree to which they experienced being pressured at work (e.g., “*I feel so pressured because I need to work long hours*”; $\alpha=.75$) on a five-point Likert scale (1=*Strongly disagree*, 5=*Strongly agree*; $\alpha=.75$). Greater scores indicate greater workload.

Work-family conflict was assessed using the five-item Work-family Conflict Scale (Italian adaptation; Colombo & Ghislieri, 2008). Respondents indicated how much they agreed with each item regarding the interference that their job demands exerted on their private life (e.g., “*The demands of my work interfere with my home and family life*”; $\alpha=.78$) on a seven-point Likert scale (1=*completely disagree*, 7=*completely agree*; $\alpha=.78$). Higher scores indicate greater WFC.

Job satisfaction was evaluated using a single item (i.e., “*How satisfied have you been with your work?*”; Italian version; Giorgi et al., 2015). Participants indicated their overall job satisfaction level on a ten-point Likert scale, where greater scores indicate greater job satisfaction.

Resilience was assessed using the ten-item Connor-Davidson Resilience Scale (Italian validation; Di Fabio & Palazzeschi, 2012). Participants indicated how much they were able to positively react to stressful situations (e.g., “*I can deal with whatever comes*”; $\alpha=.76$) on a five-point Likert scale (0=*almost always false*, 4=*almost always true*). Greater scores indicate greater resilience.

Experience with Covid-19. Participants answered three dichotomous items (0=*no*, 1=*yes*) on their experience with COVID-19, examining: having been tested for COVID-19 (i.e., “*Have you been tested for COVID-19?*”), having had colleagues tested positive for COVID-19 (i.e., “*Have any of your colleagues been diagnosed with COVID-19?*”), having suffered a loss of a loved one because of Covid-19 (i.e., “*Have any of your loved ones been among the fatalities?*”).

Statistical analyses

Firstly, the data were examined for outliers, multicollinearity, and distribution of the data using SPSS 25.0. Results indicated that multicollinearity was not an issue as the highest variance inflation factor was 1.57 and the lowest tolerance was 0.64. Additionally, skewness (ranging from -1.03 to 0.08) and kurtosis (ranging from -0.78 to 0.56) values were acceptable (George & Mallery, 2010). Then, descriptive statistics, correlations among the study’s variables, and Cronbach alphas were calculated. Contrary to our expectations, none of the socio-demographic variables statistically significantly correlated with job satisfaction. Then, following recommended practices (Aguinis & Vandenberg, 2014) and previous studies (Setti et al., 2020), we controlled our subsequent analyses for Covid-19-related variables because these variables

were the only covariates to be statistically significantly correlated with our variables of interest. Next, to identify the presence of differences based on Covid-19-related variables among research participants, we conducted a series of independent sample t-test analyses. Next, a confirmative factor analysis (CFA) with the maximum likelihood method was run comparing the measurement model with alternative competing models using Mplus Version 8.0 (Muthèn & Muthèn, 2012). Additionally, to assess whether the common method bias might affect the results of our study, we adopted the unmeasured latent method factor technique (the percentage of variance explained by the unmeasured latent method factor should be less than 25%, the average amount of method variance observed in self-report research; Podsakoff et al., 2012). Then, the hypothesized mediation model was tested using bias-corrected bootstrapping analyses with 1000 random samples while controlling for Covid-19-related variables. An indirect effect was considered statistically significant if the 95% confidence interval did not include/cross zero or a p -value higher than 0.05. To evaluate the fit of the overall model to the data, we considered the magnitude and statistical significance of factor loadings, the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). Then, we performed a moderated mediation model to verify whether resilience would moderate the effects of workload on job satisfaction through WFC.

Results

Descriptive statistics

All correlations among the study's variables were in the expected directions (see *Table 2*). The results of independent t-test analyses (see *Table 3*) showed that there were statistically significant differences in job satisfaction levels based on having been tested for Covid-19 ($t_{(165)}=2.39, p<.05$), having had colleagues tested positive for Covid-19 ($t_{(164)}=-3.41, p<.001$)

and having suffered the loss of a loved one due to Covid-19 ($t_{(165)}=-2.02, p<.05$). Specifically, ATCOs who were not tested for Covid-19 were more satisfied with their job ($M=7.01, SD=2.33$) than those who were tested for the virus ($M=6.04, SD=2.63$). Additionally, job satisfaction was higher among ATCOs who had colleagues tested positive for Covid-19 ($M=7.15, SD=2.26$) than their counterparts ($M=5.79, SD=2.66$). Lastly, ATCOs who did not lose loved ones due to Covid-19 were more satisfied with their job ($M=6.80, SD=2.43$) than those who suffered a loss ($M=5.11, SD=2.67$).

Table 2. Descriptive statistics, Cronbach's alphas and intercorrelations among the study's variables ($N=168$).

| | M | DS | Skewness | Kurtosis | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--|-------|------|----------|----------|------------|------------|------------|-------|-------|------|------|------|------|------|--------|----|
| 1. Workload | 2.61 | 1.03 | .08 | -.78 | .75 | | | | | | | | | | | |
| 2. Work-family conflict | 2.97 | 1.23 | .46 | -.57 | .59*** | .78 | | | | | | | | | | |
| 3. Resilience | 3.11 | .44 | -.29 | -.50 | -.25** | -.21** | .76 | | | | | | | | | |
| 4. Job satisfaction | 6.72 | 2.46 | -1.03 | .56 | -.39*** | -.43*** | .19* | - | | | | | | | | |
| 5. Testing for Covid-19 | - | - | | | -.00 | -.03 | .11 | -.18* | - | | | | | | | |
| 6. Positivity to Covid-19 | - | - | | | .05 | .08 | -.05 | -.08 | .20** | - | | | | | | |
| 7. Colleagues tested positive for Covid-19 | - | - | | | -.11 | -.17* | .02 | .26** | -.07 | .09 | - | | | | | |
| 8. Loved ones vulnerable to Covid-19 | - | - | | | .07 | .15 | -.06 | -.06 | -.02 | .07 | .01 | - | | | | |
| 9. Loss of loved ones to Covid-19 | - | - | | | -.05 | .00 | .00 | -.16* | .13 | .17* | .11 | .00 | - | | | |
| 10. Gender | - | - | | | .02 | .01 | .11 | .01 | .13 | .10 | -.12 | -.04 | .08 | - | | |
| 11. Age | 44.76 | 7.86 | | | -.05 | -.02 | -.02 | .15 | -.06 | -.04 | .10 | -.07 | -.08 | -.10 | - | |
| 12. Job tenure | 15.54 | 8.49 | | | .11 | .07 | -.09 | .07 | -.07 | .01 | .10 | -.11 | .01 | -.06 | .58*** | - |

Note. Boldfaced numbers on the diagonal represent Cronbach's alpha; M = means; SD = standard deviations; * $p < .05$; ** $p < .01$; *** $p < .001$. Gender: 0=male, 1=female; Age: measured in years; Job tenure: measured in years; Testing for Covid-19: 0=no, 1=yes; Positivity to Covid-19: 0=no, 1=yes; Colleagues positive to Covid-19: 0=no, 1=yes; Loved ones vulnerable to Covid-19: 0=no, 1=yes; Loss of loved ones to Covid-19: 0=no, 1=yes.

Table 3. Mean, standard deviations, t-values of job satisfaction based on the direct or vicarious exposure to Covid-19.

| | Groups | N | Job satisfaction | | t | p | Cohen's d | 95% CI | |
|---------------------------------|--------|-----|------------------|------|------|------|-----------|--------|------|
| | | | M | SD | | | | LL | UL |
| Testing for Covid-19 | No | 115 | 7.01 | 2.33 | 2.39 | .02 | .39 | .17 | 1.77 |
| | Yes | 52 | 6.04 | 2.63 | | | | | |
| Colleagues positive to Covid-19 | No | 53 | 5.79 | 2.66 | - | .001 | .55 | - | -.57 |
| | Yes | 113 | 7.15 | 2.26 | | | | | |
| Loss of loved ones to Covid-19 | No | 158 | 6.80 | 2.43 | 2.02 | .04 | .66 | .03 | 3.34 |
| | Yes | 9 | 5.11 | 2.67 | | | | | |

Note. M=means; SD= standard deviations; CI= confidence interval; LL=lower limit; UL=upper limit.

Measurement model and control of common method bias

The results of the CFA assessing the measurement part of our hypothesized model (see Table 4) showed that the three-factor model outperformed all the alternative models ($\chi^2[132]=202.14$, RMSEA=.06, SRMR=.07, CFI=.90, TLI=.89). However, the errors of one pair of items from the WFC scale were correlated to improve the fit indices of this model ($\chi^2[131]=180.93$, RMSEA=.05, SRMR=.06, CFI=.93, TLI=.92). The following structural equation model was calculated incorporating this modification index.

Given that workload, work-family conflict, job satisfaction, and resilience were assessed at the same time by the same source, common method bias within time points can occur. Accordingly, we adopted the unmeasured latent method factor technique (Podsakoff et al., 2012) to analyse this issue with CFA. The results revealed that the fit of the hypothesized model improved after the inclusion of the unmeasured latent method factor ($\chi^2[113]=136.92$, RMSEA=.04, SRMR=.05, CFI=.97, TLI=.96). Additionally, the unmeasured latent method factor explained

12.00% of the total variance, which is lower than the median amount of method variance (25%) observed in self-report studies (Podsakoff et al., 2012). Then, the results indicate that the common method bias seemed unlikely to represent a major concern in our study.

Table 4. Fit indices for the three-factor model and the alternative models.

| Model | χ^2 | df | p | RMSEA A | 90% CI RMSEA | SRM R | CF I | TLI |
|---|----------|-----------|----------|--------------------------|-------------------------------|------------------------|-----------------------|------------|
| <i>Three-factor model cmb^g</i> | 136.916 | 113 | .06 | .04 | [.00, .06] | .05 | .97 | .96 |
| <i>Three-factor model mod^f</i> | 180.934 | 131 | .00 | .05 | [.03, .06] | .06 | .93 | .92 |
| <i>Three-factor model^e</i> | 202.135 | 132 | .00 | .06 | [.04, .07] | .07 | .90 | .89 |
| <i>Two-factor model 1^d</i> | 228.680 | 134 | .00 | .07 | [.05, .08] | .07 | .87 | .85 |
| <i>Two-factor model 2^c</i> | 361.275 | 134 | .00 | .10 | [.08, .11] | .12 | .68 | .64 |
| <i>Two-factor model 3^b</i> | 407.116 | 134 | .00 | .11 | [.10, .12] | .12 | .62 | .56 |
| <i>One-factor model^a</i> | 434.833 | 135 | .00 | .12 | [.10, .13] | .12 | .58 | .53 |

Note. df= degree of freedom; RMSEA= Root Mean Square Error of Approximation; C.I. = Confidence Intervals; SRMR= Standardized Root Mean Square Residuals; CFI= Comparative Fit Index; TLI= Tucker-Lewis Index.

^a All indicators load on a single factor.

^b Resilience and work-family conflict load on one factor, workload loads on a second factor.

^c Workload and resilience load on one factor, work-family conflict loads on a second factor.

^d Workload and work-family conflict load on one factor, resilience loads on a second factor.

^e Workload, work-family conflict and resilience load on their respective factors.

^f Prior model allowing the correlation between a pair of items from the work-family conflict scale (item 5 with item 1).

^g Previous model with the inclusion of a common method latent variable on which all items are loaded.

Hypotheses Testing

Following methodologists' suggestions (e.g., Cheung & Rensvold, 2002) the model goodness of fit was considered acceptable when CFI and TLI values were above .90 (Bentler, 1990; Tucker & Lewis, 1973), RMSEA and SRMR values were, respectively, less than .08 (Steiger, 1990) and less than .07 (Jöreskog & Sörbom, 1993). Accordingly, our mediation model ($\chi^2[48]=62.79$, RMSEA=.04, SRMR=.06, CFI=.97, TLI=.96) showed satisfactory fit indices.

The results of this model indicated that workload was positively associated with WFC ($\beta=.74$, $SE=.07$, $p<.001$, $95\%CI [.58, .86]$), while it was negatively but not statistically significantly related to job satisfaction ($\beta=-.12$, $SE=.13$, $p=ns$, $95\%CI [-.39, .14]$; see *Table 5*). WFC, in turn, was negatively associated with job satisfaction ($\beta=-.43$, $SE=.13$, $p<.01$, $95\%CI [-.69, -.17]$) and fully mediated the workload-job satisfaction relationship ($\beta=-.32$, $SE=.10$, $p<.01$, $95\%CI [-.60, -.16]$). The indirect effect was negative, suggesting that when ATCOs perceived a high workload, they were more likely to develop WFC which, in turn, was negatively related to job satisfaction. Additionally, having been tested for Covid-19 ($\beta=-.16$, $SE=.07$, $p<.05$, $95\%CI [-.29, -.03]$), and having lost loved ones due to Covid-19 ($\beta=-.16$, $SE=.07$, $p<.05$, $95\%CI [-.29, -.03]$) correlated negatively with job satisfaction, while having had colleagues tested positive for Covid-19 was positively associated with job satisfaction ($\beta=.18$, $SE=.07$, $p<.01$, $95\%CI [.06, .31]$). These results confirmed *Hypotheses 1, 2, and 3*.

The results of our moderated mediation analyses (see *Figure 2* and *Table 6*) demonstrated that the relationship between workload and job satisfaction through WFC was conditional on resilience levels, while controlling for Covid-19-related variables. The interaction effect was negative ($\beta=-.14$, $SE=.07$, $p<.05$, $95\%CI [-.29, -.00]$) suggesting that with the increase of resilience levels, ATCOs were less likely to develop WFC even under heavy workloads. ATCOs with high ($\beta=-.62$, $SE=.23$, $p<.01$, $95\%CI [-1.08, -.16]$) and moderate ($\beta=-.77$, $SE=.26$, $p<.01$, $95\%CI [-1.28, -.26]$) resilience were at lower risk of experiencing job dissatisfaction as a result of WFC under heavy workload conditions than those with low resilience ($\beta=-.92$, $SE=.31$, $p<.01$, $95\%CI [-1.54, -.31]$). Despite the moderation effect of resilience, workload still had a significant negative relationship with job satisfaction via WFC. Examination of the interaction plot (see *Figure 3*) showed that ATCOs with high resilience were less likely to develop WFC than those with low resilience in the passage from low to high workload conditions.

Table 5. Fit indices and standardized direct and indirect effects for mediation model analyzing the impact of workload on job satisfaction via work-family conflict.

| Model | χ^2 | df | p | RMSEA | 90% C.I. | SRMR | CFI | TLI |
|--|----------|----|------|-----------------|-------------|---------------|-----|-----|
| <i>Model 1</i> | 62.788 | 48 | .074 | .04 | .00, .07 | .06 | .97 | .96 |
| Standardized direct and indirect effects | | | | | | | | |
| <i>Effects- Model 1</i> | | | | <i>Estimate</i> | <i>S.E.</i> | <i>95% CI</i> | | |
| Workload → WFC | | | | .74*** | .07 | [.58, .86] | | |
| WFC → Job satisfaction | | | | -.43** | .13 | [-.69, -.17] | | |
| Test → Job satisfaction | | | | -.16* | .07 | [-.29, -.03] | | |
| Colleagues → Job satisfaction | | | | .18** | .07 | [.06, .31] | | |
| Loss → Job satisfaction | | | | -.16* | .07 | [-.29, -.03] | | |
| Workload → Job satisfaction | | | | -.12 | .13 | [-.39, .14] | | |
| Workload → WFC → Job satisfaction | | | | -.32** | .10 | [-.60, -.16] | | |
| Total effects on Job satisfaction | | | | -.44*** | .07 | [-.57, -.30] | | |

Note. *p<.05; **p<.01; ***p<.001. S.E.= standard errors; df= degree of freedom; RMSEA= Root Mean Square Error of Approximation; C.I. = Confidence Intervals; SRMR= Standardized Root Mean Square Residuals; CFI= Comparative Fit Index; TLI= Tucker-Lewis Index. WFC = Work-family conflict; Test = Testing for Covid-19; Colleagues = Colleagues positive to Covid-19; Loss = Loss of loved ones to Covid-19.

Table 6. Path coefficients and standardized conditional effects for the model with resilience as moderator of the association between workload and work-family conflict.

| Model: Workload*Resilience→ WFC→ Job satisfaction | Conditional effects | | |
|--|---------------------|------|---------------|
| | Estimate | S.E. | 95% CI |
| Workload→ WFC | .72*** | .07 | [.58, .85] |
| WFC→ Job satisfaction | -.42** | .13 | [-.68, -.17] |
| Workload*Resilience→ WFC | -.14* | .07 | [-.29, -.00] |
| Workload→ Job satisfaction | -.13 | .13 | [-.39, .13] |
| Resilience→ WFC | -.08 | .09 | [-.28, -.03] |
| Test → Job satisfaction | -.16* | .06 | [-.28, -.03] |
| Colleagues → Job satisfaction | .18** | .07 | [.05, .31] |
| Loss → Job satisfaction | -.16* | .06 | [-.29, -.03] |
| Workload*Low Resilience→ WFC → Job satisfaction | -.92** | .31 | [-1.54, -.31] |
| Workload*Moderate Resilience→ WFC→ Job satisfaction | -.77** | .26 | [-1.28, -.26] |
| Workload*High Resilience→ WFC→ Job satisfaction | -.62** | .23 | [-1.08, -.16] |
| Total effects for job satisfaction at Low resilience levels | -1.26*** | .23 | [-1.72, -.81] |
| Total effects for job satisfaction at Moderate resilience levels | -1.11*** | .22 | [-1.53, -.69] |
| Total effects for job satisfaction at High resilience levels | -.96*** | .24 | [-1.42, -.49] |

Note. *p<05; **p<.01; ***p<.001. S.E.= standard errors; C.I. = Confidence Intervals; WFC = Work-family conflict; Test = Testing for Covid-19; Colleagues = Colleagues positive to Covid-19; Loss = Loss of loved ones to Covid-19.

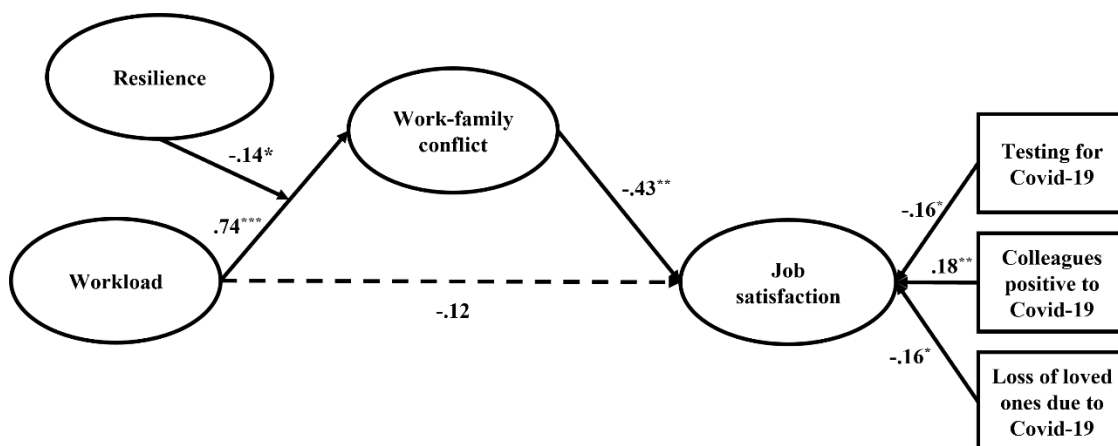


Figure 2. Path coefficients of the hypothesized moderated mediation model analyzing the relationship between workload and job satisfaction through WFC and the moderating role of resilience.

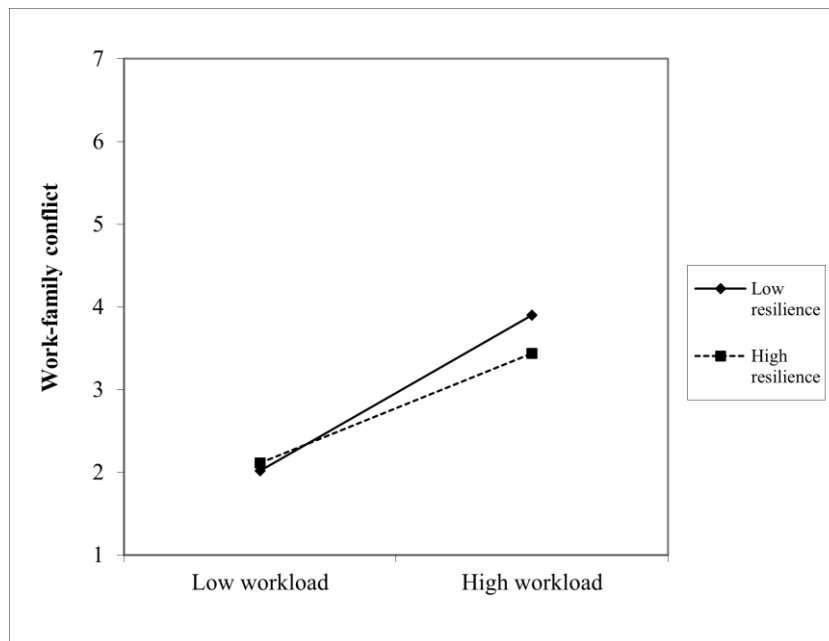


Figure 3. Moderating effects of resilience in the relationship between workload and work-family conflict.

Qualitative interviews

Participants and sampling

The same ATCOs who were contacted for the quantitative part of this research were invited through newsletters to participate voluntarily in individual semi-structured in-depth interviews. ATCOs who agreed to participate were required to select their suitable time slot using a Doodle form and provide their contact information and informed consent. Then, the first author sent the interview link to each volunteer. Interview reminders were sent one day before the interview. In total, ten ATCOs were interviewed remotely using the Zoom platform between September and October 2021.

Interview design

The interviews were conducted to hear participants' perceptions and to deepen our understanding of the quantitative findings. A semi-structured interview guide was designed based on the results that emerged from the quantitative data analysis. A panel of four experts (two academic researchers and two qualitative analyses experts) was formed to authenticate the

interview guide. During the interviews, participants were first informed about the content and aims of the interviews. Then, using the funnelling technique, the ATCOs answered some open-ended questions regarding their experience with the pandemic and their perceptions of sources of job stress, work-life interface, and satisfaction with job-related factors (See Supplemental Material S1). During the interviews, the researchers facilitated the free expression of ATCOs' views by using active listening, reformulation, and checking techniques. The interviews were conducted in Italian and lasted approximately 60 minutes.

Analysis of Interviews

Verbatim transcriptions of the interviews were analysed using NVivo 12.0 software. First, the interviews were thoroughly read, and the emerging initial codes were developed. The codes were revised to merge duplicate codes and combine similar codes in thematic categories. To reach reliability, two independent coders performed their analyses independently, developing codes and thematic categories that were subsequently matched with those of the first author. Once finished, all researchers compared their results. The few differences found were adjusted by discussing them with a fourth researcher.

Results

To achieve saturation, ten ATCOs were interviewed (see *Table 7*). This sample was quite representative of that of the quantitative investigation. Forty-four codes were identified and grouped into nineteen thematic categories that fell within the following six main themes:

- (1) The impact of Covid-19 pandemic;
- (2) Double-edged job characteristics;
- (3) Job-related risk stressors;
- (4) Protective resources;
- (5) Work-life interface;

(6) Consequences.

Table 7. Demographic characteristics of the interviewees.

| ID | Gender | Job tenure | Job role | Working area |
|-----|--------|------------|----------------------------|----------------|
| P1 | Men | 26 | Air traffic controller | Northern Italy |
| P2 | Female | 19 | Air traffic controller | Central Italy |
| P3 | Female | 25 | Air traffic controller | Central Italy |
| P4 | Men | 10 | Air traffic controller | Northern Italy |
| P5 | Men | 19 | Air traffic controller | Northern Italy |
| P6 | Female | 25 | Air traffic controller | Northern Italy |
| P7 | Female | 27 | Operational safety manager | Southern Italy |
| P8 | Men | 17 | Air traffic controller | Northern Italy |
| P9 | Men | 31 | Operational safety manager | Southern Italy |
| P10 | Men | 12 | Air traffic controller | Northern Italy |

Note. Job tenure is reported in years. Operational safety manager is an air traffic controller responsible for analysing critical events and incidents to find their causes and solutions to prevent them in the future.

Theme 1: The impact of Covid-19 pandemic.

ATCOs reported that the Covid-19 pandemic impacted their daily work activities because of the sudden fluctuations in air traffic volume that progressed from a dramatic fall in air travel during the first waves of Covid-19 to a return to pre-pandemic airline traffic during the last months of 2021. This latter condition required them to get back to managing a considerable workload after a decreased activity period. Moreover, ATCOs who covered the operational safety manager position had to adjust themselves to changes in working habits, including working from home. Additionally, ATCOs experienced Covid-19-related consequences not only on their emotional sphere, including loneliness, fear, and feelings of inadequacy, but also on their cognitive sphere, including concerns about one's own health and intrusive thoughts. ATCOs indicated that their company adopted several measures for virus containment, which included: protective mask wearing, subdivision of the work group into smaller teams, social distancing, hands sanitization and body temperature measurement. Interviewees acknowledged that these measures were effective in limiting Covid-19 transmission, as evidenced by the fact

that no infection occurred on the job. Finally, ATCOs reported that the pandemic gave rise to interpersonal conflicts at work linked to the personal choice of whether to be vaccinated or not (see Table 8).

Table 8. The impact of the Covid-19 pandemic.

| Categories | Coding | Quotation with participant number (P) | %(N) |
|---|--|--|-------|
| Professional level | Variations in air traffic | “The pandemic has definitely impacted on a practical level in the sense that the traffic got very close to zero during the first wave of lockdowns.” (P3); “The obstacle was to restart dealing with sudden increases in air traffic volumes, after a year where we worked with very little air traffic.” (P6) | 50(5) |
| | Change in working habits | “My work has also changed from an organizational viewpoint cause we started working from home; I have never stopped working. And, though much has changed, such as air traffic control/management events and technologies, I have always continued to work.” (P7) | 20(2) |
| Interpersonal level | Interpersonal conflicts | “The issue of cafeteria management and personal choices related to the Covid-19 certificate is exacerbating internal tensions and generating issues between colleagues that I never imagined (...) this is very bad for teamwork because, unfortunately, it affects people on a personal level.” (P5) | 30(3) |
| | Loneliness | “Basically, I felt lonely, I suffered much the distance from my loved ones.” (P1) | 20(2) |
| | Fear | “The fear of what would happen to my sick relatives or to a colleague who was tested positive for Covid-19.” (P5) | 20(2) |
| Emotional and cognitive level | Concerns for one’s own health | “Be careful and concerned about one’s own health.” (P3) | 10(1) |
| | Intrusive thoughts | “We brought our family troubles or difficulties in understanding what was going on in the world to work.” (P5) | 10(1) |
| | Feelings of inadequacy | “Following the drastic reduction in air traffic, we did not keep up the pace of certain automatic tasks. This generated feelings of being inadequate in terms of responding to operative requests.” (P5) | 10(1) |
| Organizational measures to contain Covid-19 | Use of protective masks | “You have to wear a protective mask all day.” (P1) | 60(6) |
| | Group division in smaller teams | “Our group of 50 was split into two separate teams of 25 who seldom met each other.” (P1) | 50(5) |
| | Social distancing | “Usually, we work closely together in pairs, we are like desk buddies. And yet, the company decided to separate us into two distant workstations.” (P8) | 40(4) |
| | Hand sanitization and body temperature measurement | “When you disconnect and reattach from the radio frequency, you need to sanitize your hands. Before returning to your workstation, you need to measure your temperature and wash your hands.” (P2) | 20(2) |
| Colleagues tested positive for Covid-19 | Efficacy of organizational anti-Covid measures | “Yes, we had colleagues positive to the virus, but no outbreaks occurred within the company because of them. Then, I must admit that the measures adopted by the company have been completely adequate.” (P5) | 60(6) |

Theme 2: Double-edged job characteristics.

ATCOs reported that work shifts, and teamwork represent double-edged aspects. On the one hand, working shifts allowed them to take weekends off without requesting vacation days and relax themselves in uncrowded spots while most other people were working. On the other hand, working shifts sometimes required them to work weekends and take time to recover from the considerable depletion of their energies. Similarly, teamwork was pleasant or not depending on what colleagues were working a shift together (see *Table 9*).

Table 9. Double-edged job characteristics.

| Categories | Coding | Quotation with Participant Number (P) | %(N) |
|------------|--------------------------|---|---------|
| Shifts | Night and weekend shifts | “Yes, I’m working tonight, and I will work next weekend both Saturday and Sunday. We have a weekend off per month but, on the other days, you can work all weekend and night shifts. No holidays.” (P5); “I have a whole weekend off per month by contract, the other three may happen to be off but you can’t be sure. If you don’t ask for vacation days, you can find yourself working on a public holiday.” (P2) | 100(10) |
| | Extra-work management | “I personally prefer working on shifts cause having a Monday or a Tuesday morning off allows you to do so many things: you can go to places that are closed in the afternoon, such as public offices.” (P4) “Working on shifts and having the morning off allow you to go for a bike ride when others are at work, it’s a bit like being on vacation.” (P1) | 60(6) |
| | Recovery after shift | “At the end of a tough shift, I stayed an hour or even more on the sofa at home staring at the ceiling.” (P5) | 30(3) |
| Teamwork | Working as a team | “It’s a team-based job. Sometimes the team itself can create stress, in the sense that some teams get you right away, while in others there is a person who tries to dominate, stands out and makes you uncomfortable.” (P4); “When you’re on shift with your peer-course whom you shared your path with, the day flies. But if you’re with the one you don’t get along with, the day seems never to end (...). Unbalanced team impacts work.” (P8) | 30(3) |

Theme 3: Job-related risk stressors.

Most interviewees identified workload as the main source of stress, underlying that they had to invest considerable cognitive energies to manage multiple, and complex tasks (i.e., multi-tasking) as well as emotive energies to handle unexpected/critical events under time-pressured situations. The workload was particularly overloaded during traffic peaks. Variations in air

traffic volume required ATCOs to continuously adjust their attention levels to rapidly changing air traffic conditions. Other mentioned sources of stress were related to staff shortages, outdated or non-working technological instruments, unclear internal communication, poor career opportunities, and poor involvement in decision-making processes (see *Table 10*).

Table 10. Job-related risks stressors.

| Categories | Coding | Quotation with Participant Number (P) | %(N) |
|-----------------------------------|--|--|-------|
| Workload | Difficulties in multi-tasking | “It often happens that you receive calls on two different radios and, at the same time, on the phone: it is crucial in our work to set priorities. And quite often, during times of peak traffic, you have to coordinate an arriving aircraft and a departing aircraft while responding to their radio calls. But, at the same time, you receive other radio calls for requests of necessary maintenance of the runway and other phone calls (e.g., the management company), which is quite complex.” (P4) | 80(8) |
| | Cognitive and emotional efforts | “When you work with so much traffic, so many things to solve, you feel the adrenaline rush that makes you feel good. Then, you pay it at the end of the shift: sometimes you get home, and you don’t want to hear anything or anyone.” (P1) | 70(7) |
| | Traffic peaks | “What is stressful is the irregular amount of traffic which requires you to have peaks of attention with their subsequent lowering. This continuous fast and loose becomes quite burdensome.” (P5) | 40(4) |
| | Unexpected or critical events | “This is a stressful job because you can have higher stress peaks when you have to manage critical traffic situations.” (P9) | 40(4) |
| | Time pressure | “Air traffic controller’s activity must be efficient in the quickest time possible.” (P2) | 30(3) |
| | Staff shortages | “We are often understaffed. This weighs down our perception of the work because it was one thing to carry out the task when we were well-staffed, quite another to carry it out now that we are under-staffed. Doing the same things can be, sometimes, particularly heavy at certain times.” (P3) | 20(2) |
| Technological equipment | Outdated/non-working instrumentation | “We still use the Marconi radio, the analogy radio, as in the early 900, so the technological issues exist.” (P8) | 60(6) |
| | Unclear internal communication | “(…) to understand what it takes, you have to chat in the hallways and act informally.” (P8) | 20(2) |
| Undervaluation of human resources | Lack of involvement in decision making processes | “The involvement of colleagues in all the non-operational phases of the work is poor.” (P8) | 10(1) |
| | Lack of career opportunities | “This is the most stressful part for me because after spending 10 years in the same position doing the same tasks, you’re always in the same place, and you have the same job. This creates a state of stagnation.” (P10) | 10(1) |

Theme 4: Protective resources.

Three protective resources emerged from the interviews: a) resilience that was considered crucial in managing demanding situations in the work and personal/family domains and learning from adversities; b) support from colleagues that included instrumental (e.g., change of shifts) and emotional forms of support (e.g., concern of others’ wellbeing); c) previous work experience that represented an important source of information that guided ATCOs on how to handle different tasks (see *Table 11*).

Table 11. Resources of air traffic controllers.

| Categories | Coding | Quotation with Participant Number (P) | %(N) |
|------------|-------------------------|--|-------|
| Personal | Resilience | “I think it’s crucial to be able to... manage, or at least recognize, your reactions to different events. If you can recognize your emotions and reactions, you can better manage them, not enduring them passively. This is fundamental not only for your working life but also for your everyday and family life. Learning how to handle this is one of the best things that could happen. I think this is resilience: being able to handle situations that at first, you don’t know why they happened.” (P6); “It’s a personal characteristic that you absolutely must have. If you don’t already have it, you have to learn to train it, because you can’t be conditioned too much by what happens around you.” (P1) | 80(8) |
| Social | Support from colleagues | “I am very willing to make shifts changes, but I see that, just as I am available for others, others are available for me when I need.” (P4); “We care about interpersonal relationships, we like to know if the colleague at home has a good situation, etc. We keep an eye on each other.” (P8) | 40(4) |
| Cognitive | Prior work experience | “The experience leads you to have the ability to decide what are the things you need to do first, allowing you to finish everything in time.” (P1); “After some time, you know exactly where you have to put a little more attention and where a little less.” (P2) | 30(3) |

Theme 5: Work-life interface.

Multiple forms of WFC emerged from the interviews: a) behavior-based, when ATCOs behaved at home as they behaved at work (e.g., asking partner for unnecessary explanations); b) strain-based, when they carried home stress arising from the management of high-risk events or interpersonal conflicts at work, compromising the quality of their presence at home; c) time-based when ATCOs devoted their extra-work time to the fulfilment of job requests, keeping working at home. Unlike, others referred that they could easily maintain a good work-life

balance by adopting time management or segmentation strategies, taking time for self-care, benefiting from flexible shift schedules, or seeking support from family members (see *Table 12*).

Table 12. Work-life interface.

| Categories | Coding | Quotation with Participant Number (P) | %(N) |
|--|--|---|-------|
| Work-family conflict | Behaviour-based | “One of the professional distortions is the sluggishness in decision-making cause at work you have to choose quickly, justifying everything. When you come home, for yourself everything must have its own place. Then, "why didn't you put the cup in its place?". So, you have to find a person who gives you a little leeway, a person who can understand and tolerate everything, otherwise there are very negative consequences. The work definitely affects the person closest to you who must make sure to understand you.” (P5) | 40(4) |
| | Strain-based | “When something happens to me at work (such as near-collisions) it creates not few worries for me that I take home and distract me from my family life cause my mind is still on that event.” (P6) | 30(3) |
| | Time-based | “Sometimes the time at work is not enough and I just keep working at home.” (P7) | 20(2) |
| Work-family balance | No influence of work on personal life | “The great thing about this job is that, as it may be stressful when you clock out, you don't have to think about anything anymore. You get home tired but after half an hour or even less you recover. My job does not affect my relationships with the people around me. When I'm particularly tired you see I say it, but my work does not affect my personal life.” (P10) | 40(4) |
| Work and personal life boundaries management | Time management | “At home, we have a Google shared calendar on which we mark our appointments and those of our daughters.” (P8); “I have a slavish organization of everything I have to do, from work to life... the joints of various things.” (P3) | 40(4) |
| | Self-care | “I forced myself to take at least an hour a day for myself and I can do it. During that time, I can cycle, study, make cultural visits, go urban trekking here in my area, or cultivate friendships.” (P2) | 30(3) |
| | Flexibility of shifts | “You can swap shifts.” (P10); “When someone needs a shift change and finds some available colleague who respects the rules and cycles of the shifts, the company allows the change.” (P9) | 30(3) |
| | Social support seeking from family members | “I have a family network that supports me, so in taking care of my daughter I can rely on grandparents.” (P6) | 20(2) |

| | | |
|------------------------|--|-------|
| Work-life segmentation | “I don’t see my colleagues out of work. Though I have many friendships with my colleagues, we see each other periodically like everyone else, I don’t think about work out of work, as I organize myself.” (P8); “I’m not a person who normally goes out with colleagues, I don’t like it. I separate my personal life from my work. It helps me maintain mental health.” (P2) | 20(2) |
|------------------------|--|-------|

Theme 6: Consequences.

Almost all interviewees reported that they were completely satisfied with their job in general. More specifically, while some interviewees reported that they were particularly satisfied with the opportunity to easily balance work and family life because the rostering system enabled them to have free time during the week, others appreciated how the work was organized by their company. However, others were dissatisfied with the rostering system due to frequent requests for shift swapping from the company, while others were dissatisfied with how human resources were managed. Finally, two psycho-physical health consequences emerged from the interviews: a) mental fatigue experienced by ATCOs at the end of the shift; b) difficulties in maintaining healthy circadian rhythms due to night shifts (see *Table 13*).

Table 13. Consequences.

| Categories | Coding | Quotation with Participant Number (P) | %(N) |
|--------------|------------------------|--|-------|
| Satisfaction | With the job itself | “I couldn’t be luckier cause I miss it when I’m not at work... I miss it because I like it and so, it gives me the greatest satisfaction. I have achieved my goal, so I am delighted.” (P4); “Right now I’m happy to do my job, I go to work enthusiastically.” (P5) | 90(9) |
| | With work-life balance | “Yes, I am satisfied cause I have days off and often half a day off, the whole morning or the whole afternoon.” (P10); “Yes, after so many years, a person learns how to organize. It takes a little organization.” (P3) | 50(5) |
| | With work organization | “I believe that when there are so many people there must be rules in place to prevent chaos and, in my opinion, these rules are well-defined.” (P2); “The cyclical nature of the shift is reasonable.” (P3) | 50(5) |

| | | | |
|------------------------|------------------------------|---|-------|
| | With organizational policies | “I don’t like how the staff is handled. Staff shortages and how the staff is treated no longer please me.” (P3) | 50(5) |
| Dissatisfaction | With work organization | “Looking at technologies and time management, there is a lot that should be reconsidered. I don’t think I am supposed to receive at least 2 or 3 requests to swap my shift from my company in a week (...) this means that the company does have neither the resources nor the required planning for managing these resources optimally.” (P1) | 50(5) |
| | Fatigue | “The mental fatigue that you take home (..) we are mentally drained, and this can cause troubles cause when you get home your daughter would tell you her personal things and wouldn’t see you tired or stressed out.” (P3) | 50(5) |
| Psycho-physical health | Circadian rhythm | “I don’t do shifts anymore. So, it is much better for my biorhythm. I can manage my sleep, fatigue, etc., more easily. When you work shifts you have to stay awake even while you are sleepy, eat when you’re not hungry, and so on. Now I can manage better, I sleep when I’m sleepy, I wake up when I want to wake up, I go to work when my energies allow me to do it. Working nights is tough, working after 10 p.m. is very tough.” (P9) | 40(4) |

Discussion and Managerial implications

This mixed-method study clarifies *how* and *when* workload may be negatively related to job satisfaction among Italian ATCOs during the Covid-19 pandemic. Quantitative results indicated that, when faced with a high workload, ATCOs with low (vs. high) resilience were more likely to experience WFC and then become less satisfied with their job. Contrary to our expectations, workload was not directly related to job satisfaction. This is in contrast to what was found in one of the few studies analysing the workload-job satisfaction relationship in a sample of ATCOs (Jou et al., 2013). This Taiwanese study demonstrated that workload directly predicted job dissatisfaction (Jou et al., 2013). Possible explanations for these inconsistent results might be related to cross-cultural differences between Taiwanese and Italian ATCOs (e.g., the first work on average more hours than the latter; Jou et al., 2013) and different data collection periods (pre- vs. post-pandemic times), which might have affected how ATCOs perceived and

coped with their workload. Alternatively, based on qualitative results, ATCOs' job satisfaction might have been more influenced by the work content and human resource management practices than by workload.

As far as we know, this study shows that the effects of workload spill over into the family domain, making ATCOs less equipped to face family requirements and less satisfied with their job. This result is consistent with Jou and colleagues' (2013) study showing that workload and WFC predict job dissatisfaction among ATCOs. This result also extends the findings of Baeriswyl and colleagues (2016) to the air traffic controller context by showing for the first time that WFC can be a mechanism explaining how workload is related to job dissatisfaction not only among airport security officers but also among ATCOs. This supports the idea based on the COR theory (Hobfoll et al., 2018) that excessive workload depletes ATCOs' resources, leaving them with fewer resources to handle family demands. When trying to protect their remaining resources, ATCOs can be less motivated to engage in job efforts, appraise their work role as a threat to other self-relevant roles (e.g., partner), and detach themselves from it, developing negative attitudinal consequences, including lower job satisfaction (Hobfoll et al., 2018; Lazarus & Folkman, 1984). In this regard, qualitative results revealed that, ATCOs identified three main sources of stress related to workload: the management of complex tasks (i.e., multi-tasking) and unexpected/critical events under time-pressured situations; quantitative workload during traffic peaks in understaffed conditions; and sudden variations in air traffic volume due to the pandemic. Dealing with these aspects of the job required ATCOs to invest considerable cognitive energy (e.g., attention). As a result, energy-depleted ATCOs were likely to return home mentally fatigued, making it difficult for them to pay adequate attention to family issues. While some ATCOs could effectively balance work and family by adopting different strategies (e.g., segmentation, time management), others experienced behavior-based, strain-based, and/or time-based WFC. However, three relevant

protective factors emerged from the interviews: resilience, support from colleagues, and previous work experience. Precisely, as far as we know, this is the first study to identify resilience as a protective factor against WFC among ATCOs operating under high workload conditions, thereby answering the calls for more research on workplace individual-level resilience among ATCOs (Douglas & Pittenger, 2020). In line with COR theory (Hobfoll et al., 2018), resilient ATCOs can rely on rich resource reservoirs and mobilize available resources to effectively handle heavy workload situations, maintaining enough resources to successfully fulfil family-related duties. Likewise, colleague support represents a social coping resource because it allows ATCOs to fulfil basic human needs (e.g., belongingness) and restore lost or insufficient resources when facing workload (Hobfoll et al., 2018). For instance, talking with colleagues about job-related stressors can help ATCOs overcome challenging moments, leaving them with enough energy to satisfy family requests. Accordingly, some evidence of the protective role of social support from colleagues against work-family conflict comes from investigations on cabin crew (Chen & Chen, 2012). Similarly, drawing on the COR theory (Hobfoll et al., 2018), previous work experience can be considered a relevant personal coping resource because it offers a source of information that enables ATCOs to shape comprehensive mental schemata helpful to select the most appropriate response to cope with traffic-load variations and priority-flight requests as well as predict consequences across a variety of future circumstances. This result is coherent with findings from prior research suggesting that ATCOs' mental workload decreases with a higher level of experience (Radüntz et al., 2021).

Finally, our study informs on how ATCOs' experiences with Covid-19 influenced their job satisfaction. Having colleagues tested positive for Covid-19 was positively related to job satisfaction, probably because ATCOs were satisfied with the measures for virus containment adopted by their organization. Conversely, ATCOs that were tested for Covid-19 were less satisfied with their job, probably because they were concerned about their health and afraid of

being discriminated against at work (Shahrour et al., 2021). Moreover, losing a loved one due to Covid-19 was negatively related to job satisfaction, probably because bereaved ATCOs could experience health-related disorders (Eisma et al., 2021) and then impairment in their work functioning. This is somewhat in line with prior research indicating that the Covid-19 pandemic itself was a stressful experience for aviation workers in general and airline employees due to the virus infection fears, the need to maintain social isolation, and difficulty in cultivating a positive atmosphere with close family (Paisan & Wan-Chick, 2023).

From a practical standpoint, our results suggest that air traffic organizations should match the shift schedule to reflect the increased need for personnel (especially during traffic peaks), offer flexible work arrangements as well as introduce shift swapping (at the employee discretion) and family-friendly policies to allow their staff to better manage the workload and balance work and family demands. Additionally, mentoring sessions and professional retraining courses where ATCOs are encouraged to share their experience on how to handle complex tasks and critical incidents could be helpful in mitigating their mental fatigue and strengthening social support among colleagues. These courses could incorporate education on coping skills on how to combine work and personal life (e.g., time management strategies), how to set boundaries between these two domains (e.g., cognitive-emotional segmentation strategies), and how to dedicate time for self-care. These courses should also be integrated with psychological resilience training (Joyce et al., 2018). These programs could signal to employees that their organization cares about providing them with development opportunities, maintaining their satisfaction even under slow career progression conditions. Furthermore, to keep staff satisfied, managers should improve internal communications by organizing periodic group discussions in which employees are encouraged to offer suggestions for improvement and feedback to guide decision-making. Moreover, companies could consider introducing a counselling system or a psychological support service where ATCs can express their frustrations.

Limitations and future avenue

This cross-sectional mixed-method study combined self-reported questionnaires with qualitative interviews from a single source of information, raising issues of common method bias. Thus, future mixed-method studies should adopt longitudinal techniques and collect data from different informational sources. Although data were collected on ATCOs operating throughout Italy, our sample was mainly composed of men and the interviews were conducted on a relatively small sample. Besides the specific population and context, the data collection period (i.e., during the pandemic) limits the generalizability of these results. Future research should replicate our findings on larger gender-balanced samples of Italian ATCOs during post-pandemic times, including other aviation occupations. Finally, we only tested the moderating role of resilience. Future research should identify other personal and contextual boundary conditions to test more complex moderated mediation models.

Conclusion

This mixed-method study showed that when faced with a high workload, Italian ATCOs could experience WFC, becoming less satisfied with their job. However, highly resilient ATCOs were less affected by variations in job satisfaction across workload levels. Qualitative findings confirmed and deepened these results, suggesting that some ATCOs could more easily maintain a good balance by adopting time management or segmentation strategies. Thus, air traffic organizations could maintain staff satisfaction by providing them with education on these coping strategies, psychological resilience training, and flexible shift schedules.

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