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Life Satisfaction during the Second Lockdown of the COVID-19 Pandemic in Germany: The Effects of Local Restrictions and Respondents' Perceptions about the Pandemic

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Abstract
This study examines the consequences of the pandemic on subjective well-being. First, we investigate to what extent regional and temporal differences in COVID-19 restrictions can explain individuals' life satisfaction in Germany. Second, we examine to what extent "subjective" evaluations of the pandemic are related to life satisfaction. Third, we examine whether these relationships vary with gender, parenthood, and partnership status, or whether relationships changed regarding specific sub-populations (i.e., mothers, fathers, childless women/ men). Merging representative survey data from the German Family Demography Panel Study (FReDA) and contextual data on COVID-19 restrictions (i.e., the stringency index), we analyze a sample of 32,258 individuals living in Germany in their regional settings on the NUTS-3 level during the "second lockdown" in spring 2021. Furthermore, we use the FReDA field period between April and June 2021 to assess temporal variations in COVID-19 restrictions and their association with life satisfaction. To answer our research questions, we compare aggregated means and use variance decomposition and multivariate regression models. Our results show strong regional and temporal differences in COVID-19 restrictions, but neither temporal nor regional differences in "subjective" perceived pandemic burden or in life satisfaction at the aggregated level. At the individual level, we find substantive negative associations between perceived pandemic burden and life satisfaction, which are particularly strong among mothers. Our study shows that individuals' negative perceptions of the pandemic are an important correlate to life satisfaction, whereas regional differences or temporal changes in COVID-19 restrictions appear to be irrelevant for the period under investigation.

Keywords Life satisfaction · Subjective well-being (SWB) · Corona · Non-pharmaceutical interventions · Parenting · Stringency index

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Introduction

Research on the early stage of the COVID-19 pandemic in March 2020 has shown that the perception of social isolation appears to be negatively related to life satisfaction in the US and Europe (Clair et al., 2021) and Spain (Gonzalez-Bernal et al., 2021). The severity of this relationship differs regarding several societal groups, for example, women seem to have been more affected by the pandemic, since they had lower levels of life satisfaction compared to men as indicated by a study in Greece (Anastasiou & Duquenne, 2021). In addition to perceptions, a macro-level analysis has shown that due to COVID-19 restrictions, subjective well-being varied during the pandemic in Austria (Oberndorfer et al., 2022).

However, the first studies analyzing the regional differences of the consequences of the pandemic on life satisfaction have inconclusive results. For example, in a Greece study (Anastasiou & Duquenne, 2021), geographical differences in life satisfaction were not found during the lockdown regarding urbanity or insularity, whereas findings from Japan indicated that living circumstances could play a role in subjective well-being (Soga et al., 2021). Currently, we know little about whether non-pharmaceutical interventions (NPIs) impact individuals' life satisfaction or whether the perception of the pandemic as stressful affects individuals' subjective well-being. These relationships are generally difficult to study, since NPIs often were implemented temporarily and on communal levels in so-called *hotspots* with high incident rates. For example, in Germany, some of the restrictions were implemented at the federal state level (NUTS-1) and district level (NUTS-3) according to the number of infected individuals in the given units. As representative survey data are mostly unavailable at the levels where NPIs were implemented, or the number of respondents at these levels are very low, it is hard to study the mentioned relationships.

In the present study, we investigated to what extent the "objective" COVID-19-related NPIs and "subjective" perceptions about the pandemic situation were associated with individuals' life satisfaction. Since previous research has shown that families and especially mothers (Hudde et al., 2022; Huebener et al., 2021; Möhring et al., 2021; Thorsteinsen et al., 2022) have been strongly affected by the pandemic, we also investigated whether these associations with life satisfaction varied between individuals by partnership status, gender, and parenthood. To bring together "objective" and "subjective" COVID-19-related burdens, we based our analysis on individual-level data from the German Family Demography Panel Study (FReDA) (Bujard et al., 2022; Schneider et al., 2021) and context level data on COVID-19-related restrictions provided by infas 360 (2022a, b). Our objective was to provide new insights into the consequences of the COVID-19 pandemic by accounting for regional and temporal differences in COVID-19 restrictions, perceived individual pandemic burdens, and individuals' characteristics.

Whereas previous studies mostly have referred to the early stages of the pandemic and often have relied on non-probabilistic convenience samples (Anastasiou & Duquenne, 2021; Benke et al., 2022; Bu et al., 2020; Clair et al., 2021; Gonzalez-Bernal et al., 2021; Okabe-Miyamoto et al., 2021; Thorsteinsen et al., 2022), our

study focused on the second year of the pandemic with a representative large-scale sample of the German population aged 18–49. The initial wave of the FReDA study (Bujard et al., 2022; Schneider et al., 2021) was conducted between early April and June 2021. During this time, Germany had contact restrictions from the beginning of November 2020 ("lockdown light") that were expanded in December 2020 ("second lockdown") and continued until June 2021 (Wikipedia: COVID-19 Pandemic in Germany, 2021). In addition, we analyzed the effects of COVID-19-related NPIs on life satisfaction at the regional level.

Theoretically, we discuss the concept of subjective well-being (Diener et al., 1999, 2018) and outline the relevant determinants of life satisfaction, as well as previous findings regarding the COVID-19 pandemic. Empirically, first we analyze aggregate time trends and differences between regions. Second, we use variance decomposition to distinguish the degree of regional and temporal variation in life satisfaction, COVID-19 restrictions, and individuals' perceptions of the pandemic as a burden. Third, using multivariate regression models, we test the effect of "objective" COVID-19 restrictions and respondents' "subjective" pandemic burden on life satisfaction. We also use interaction effects to test whether these effects are conditional on partnership, parenthood, and gender, and gain additional insights by subgroup analysis of the characteristics' parenthood and gender. Finally, we discuss our results in relation to previous findings on life satisfaction during the pandemic.

Background: Theory and Previous Research

Life Satisfaction over Time and Space

Life satisfaction represents the cognitive-judgmental component of the *subjective well-being* concept that is complemented by positive and negative affect (Diener et al., 1985). This combination is a tripartite measure of how individuals assess the overall quality of their lives. Thus, subjective well-being has been intensively employed to inform researchers and policy makers in their efforts to increase individual well-being (Diener et al., 2018).

For decades, subjective well-being has been perceived as a stable measure with only little variation over time. Due to methodological advances and new data sources, research has shown that this assumption does not hold equally for all three components (Diener et al., 2018). On the one hand, the emotional part of subjective well-being provides a high degree of stability, since an experience of positive and negative affect is linked to individuals' genetics and underlying personal traits that rarely change (Anglim et al., 2020; Lucas & Diener, 2009). Life satisfaction, on the other hand, shows less temporal stability, since it represents a cognitive assessment dependent on contextual influences and individuals' personal expectations and experiences (Li et al., 2014). Due to this difference in temporal variability, the present study focused on the cognitive-judgmental component of life satisfaction to examine how the COVID-19 pandemic affected individuals' subjective well-being. We assessed individuals' life satisfaction on

a single item measurement—which has proven to be valid and reliable — that asked them to rate their overall life satisfaction (Hudson et al., 2020).

Individuals' life satisfaction is a multifaceted construct associated with diverse socio-demographics and macro phenomena. The effect of gender on life satisfaction, for example, is existent, yet small, and its direction depends on regional and societal conditions such as the degree of gender equality in a given society (Tesch-Römer et al., 2008; Zuckerman et al., 2017). However, Joshanloo and Jovanovíc's (2020) study found that, in general, women are slightly more satisfied with life than men. Another well-known predictor of life satisfaction is income, which is only positively associated with life satisfaction when an individual's social rank increases simultaneously (e.g., Boyce et al., 2010).

External events also can affect an individual's assessment of cognitive life satisfaction, as shown in a meta-analysis by Luhmann et al. (2012). This linkage between life satisfaction and events is a major driver of the temporal variability of subjective well-being. The speed of changes in life satisfaction, however, varies since individuals adapt differently to events. Whereas marriage only has a positive short-term effect and life satisfaction quickly returns to pre-marital levels (Boyce et al., 2016; Lucas & Clark, 2006), severe disability or unemployment have long lasting negative effects on life satisfaction (Diener et al., 2013). Thus, adaptation processes are crucial when investigating temporal changes in life satisfaction. In general, adaptation theory assumes that individuals have personal set-points of life satisfaction to which they tend to return. However, research has shown that the speed of adaptation varies depending on individual circumstances and that a personal baseline of life satisfaction is not necessarily fixed over the life course (Kubiszewski et al., 2020; Lucas et al., 2003, 2004).

In addition to personal life events, overarching societal crisis also impacts individuals' life satisfaction. A large body of literature exists on how the financial crisis of 2007–2008 affected individuals' life satisfaction (e.g., Boyce et al., 2018; Charles et al., 2019; Mertens & Beblo, 2016). These studies have shown that it was not the external shock of the crisis per se that affected individuals' life satisfaction, but rather their subjective perception of the overall crisis (Fernandez-Urbano & Kulic, 2020). This perception depends on factors such as individual resources or comparisons with peers who are experiencing the same crisis (e.g., Charles et al., 2019; Fernandez-Urbano & Kulic, 2020).

The most recent societal crisis that has affected everyone globally is the COVID-19 pandemic. This unexpected event, with its implications on individual health and social life, motivated researchers worldwide to investigate how life satisfaction has been affected at the different stages of the pandemic (e.g., Clark & Lepinteur, 2022; Entringer & Kröger, 2021; Lepinteur et al., 2022; Möhring et al., 2021; Schmidtke et al., 2021). In this regard, social relations, family life, and working conditions were the focus of these analyses, since contact restrictions, school closures, short-time work, and working from home were key interventions to prevent the virus from spreading. This variety of interventions was further expanded by regional and temporal differences.

COVID-19 Restrictions during the "Second Lockdown" in Germany

Although COVID-19 restrictions have varied over time in Germany, our study focused only on the restrictions of the "second lockdown". In fall 2020, the incident rate of COVID-19 affected individuals increased, so the German government started a "lockdown light" in November, which it tightened in January 2021 ("hard lockdown"). Schools, shops, and body services were closed; working from home became mandatory; in closed, public places—such as stores or public transport—medical masks had to be worn; and no more than two households could meet in person. These restrictions aimed at achieving an incidence rate of less than 50 cases per 100,000 inhabitants.

On April 23, 2021, the "hard lockdown" ended, and the "Law for the Protection of the Population in the Event of an Epidemic Situation of National Significance" came into effect. Thus, communities with an incidence rate of 100 or more for 3 consecutive days had to impose restrictions again (e.g., contact restrictions, closure of restaurants, or curfews at night). This law was in effect for the last time on June 11, 2021, and since then, until the expiration of the law on June 30 2021, no community in Germany had an incidence rate above 100 for 3 consecutive days (Wikipedia: COVID-19 Pandemic in Germany, 2021). Moreover, from May 6, 2021 onward, restrictions were partially eased for vaccinated individuals, although not everyone had an opportunity to be vaccinated, since older individuals and those in the healthcare system had preference.

Even during the "hard lockdown" federal states could make decisions about numerous restrictions themselves (e.g., the opening of schools and daycare centers). Since by federal law some of the restrictions were additionally linked to the incidence of infections in individual districts and communities, the extent to which individuals were affected by COVID-19 restrictions varied, depending on the regional context.

The Impact of the COVID-19 Pandemic as a Crisis

Life satisfaction and mental health are strongly associated (e.g., Fergusson et al., 2015; Lombardo et al., 2018). In particular, factors such as depressiveness lead to lower life satisfaction (Rissanen et al., 2011). Therefore, when considering the impact of the pandemic as a crisis, both life satisfaction and mental health are relevant. A literature review that considered many studies on mental health in Western countries during the first year of the pandemic found no change in life satisfaction (Aknin et al., 2022), although anxiety, depression, and distress increased at the beginning of the crisis. Nevertheless, significant differences existed between individual groups and countries.

German studies produced mixed results and varied with the pandemic time under investigation: when overall life satisfaction in pandemic and pre-pandemic times was compared, no significant difference was found using data from a German online panel (Zacher & Rudolph, 2020), and Socio-Economic Panel (SOEP) data

(Entringer et al., 2020). However, when distinguishing between men and women who participated in the SOEP, Lepinteur et al. (2022) found women's life satisfaction to be at significantly lower levels in the first year of the pandemic compared to 2017. Bittmann (2022) who relied on German National Educational Panel Study (NEPS) data also found a sharp decline in life satisfaction already from the beginning of the pandemic. The negative effect of the pandemic on individuals' life satisfaction is further supported by studies investigating later stages of the pandemic which found evidence for a significant decline in life satisfaction, for example, between March 2020 and May 2020 (Zacher & Rudolph, 2020) and between the "first lockdown" and the "second lockdown" (Entringer & Kröger, 2021). Moreover, Benke et al. (2022) showed that while the scores for loneliness and depression initially remained relatively stable after the onset of the COVID-19 pandemic, higher scores for these factors and lower life satisfaction were observed after one year.

First results using a stringency index showed that the strength of restrictions had an impact on life satisfaction. For example, in Austria, life satisfaction at the macro-level varied with the strength of COVID-19 restrictions over time (Oberndorfer et al., 2022). Furthermore, in a comparison of Italy, France, Spain, Germany, and Sweden, stricter government restrictions were associated with a higher decrease in life satisfaction (Clark & Lepinteur, 2022). Especially women, unemployed individuals, and individuals with a high income suffered from a sharp drop in life satisfaction. The variation in COVID-19 restrictions within Germany and previous findings led us to investigate to what extent temporal and regional variations of COVID-19 restrictions in Germany were related to the different levels of life satisfaction (RQ1).

According to stress theory, the impact of stressors or critical life events such as the COVID-19 pandemic vary among individuals. The impact of critical events and stressors depend on individuals' experiences and perceptions of situations, which, in turn, are determined by personality and life circumstances (Lazarus and Folkman, 1987). The subjective assessment of a situation and individual reactions to crises also always depends on the cultural or country-specific context. Regarding the COVID-19 pandemic, for example, the realities of life differed for individuals living in different countries (e.g., no-COVID strategy in China versus permissive restrictions in Sweden) but also within the same country (i.e., Germany). Since COVID-19 restrictions varied within Germany, we examined whether the perception of the pandemic varied between regions. Then, we examined to what extent the perception of the pandemic was related to individuals' life satisfaction (RQ2).

Previous findings have provided evidence for differences in life satisfaction between women and men during the COVID-19 pandemic that are in contrast to the overall findings that women were somewhat better off with respect to life satisfaction (Joshanloo & Jovanović, 2020). Thus, women reported higher levels of stress and loneliness than men (Hiekel & Kühn, 2022), their well-being was more strongly affected (Clark & Lepinteur, 2022), and their life satisfaction was lower (Anastasiou & Duquenne, 2021).

Given the COVID-19-related home confinement and restrictions of social contacts, partners and children played a key role in individuals' life satisfaction during the pandemic. In general, a partner had a large impact on an individual's well-being (e.g., Diener & Seligman, 2002). Particularly when contact

restrictions were in effect, living with a partner helped to maintain social connectedness (Okabe-Miyamoto et al., 2021). Research on the impact of having children on mental health is not entirely consistent. Some studies have claimed that parents generally have higher life satisfaction and are happier (e.g., Aassve et al., 2012), whereas other studies found that parents have more stress, lower life satisfaction (e.g., McLanahan & Adams, 1987), and more limitations in their mental health (e.g., Evenson & Simon, 2005). The differences in these studies appear to be attributable to parental strain and stress (Nelson et al., 2014; Nomaguchi & Milkie, 2020), which also are part of the equation. In the first lockdown in 2020, families with young children were particularly burdened, and parents' life satisfaction has declined (Huebener et al., 2021).

Overall, the results of these various studies have found that several subgroups (women, parents, and singles) have particularly suffered from the impacts of the COVID-19 pandemic. Therefore, we explored whether the association between the perceived pandemic situation and life satisfaction differed among subgroups by gender, parenthood, and partnership status (RQ3). In addition, we checked whether relationships changed when examining sub-populations along the dimensions of gender and parenthood.

Data, Operationalization, and Method

Data

FReDA is a large biannual panel study of the German population aged 18–49 (Schneider et al., 2021). The nationally representative sample is drawn from a total of 320 sampling points in 258 municipalities. The study focuses on family demographic topics such as processes and transitions in couples' relationships, fertility and parenthood, and respondents' economic situations and attitudes. Data for the present study comes from the first recruitment wave (W1R) of FReDA in which 37,783 respondents participated in a short survey of approximately 10 min (Bujard et al., 2022). These interviews were conducted by self-administered modes (web-based or paper-based) from April 7 until June 29, 2021. Besides the FReDA recruitment wave, data from wave 1 for the anchor as well as partner have been released in 2023 and data for wave 2 is going to be released in 2024.

After a listwise deletion of missing values from the full FReDA sample, our analytical sample encompassed a total of 32,258 respondents (see Table A2 in the Online Appendix for missingness and a comparison of full and analytical sample). We used this sample to examine the relationship between the regional and temporal differences of COVID-19 restrictions and respondents' life satisfaction. Furthermore, in the multivariate analyses, we analyzed the sub-populations of mothers ($N = 9{,}265$), childless women ($N = 8{,}314$), fathers ($N = 6{,}528$), and childless men ($N = 8{,}151$).

Operationalization

Life Satisfaction Our outcome variable depicted general life satisfaction. On an 11-point scale, where 0 means "not at all satisfied" and 10 means "completely satisfied" respondents were asked to evaluate their life satisfaction at the beginning of the survey by answering the question: "All things considered, how satisfied are you with your life as a whole nowadays?".

Exposure to COVID-19 Restrictions (Stringency Index) Our first main independent variable measured respondents' "objective" exposure to COVID-19 restrictions at their address. In Germany, the implementation of COVID-19 restrictions was at the district level (NUTS-3). To capture the exogenous exposure to COVID-19 restrictions, we utilized the COVID-19 stringency index provided by the infas institute for Applied Social Science and infas 360 GmbH (Follmer et al., 2021; infas 360 GmbH, 2022a, b). Infas collected information on the containment and relaxation of restrictions in Germany at the federal and district levels from March 1, 2020 until December 31, 2021.[1]

To assess the severity of COVID-19 restrictions, infas methodologically followed the Oxford COVID-19 Government Response Tracker (OxCGRT)[2] (Hale et al., 2021). Accordingly, official documents on COVID-19 protection measures were content analytically coded into 23 supercategories (see Table A1 in the Online Appendix for an overview) and 537 subcategories for all 16 federal states and 401 districts in Germany. The 23 supercategories focused on different areas of restriction and relaxation, such as, for example, childcare (M03) or gastronomy (M08), whereas the subcategories depicted the detailed individual measures within these supercategories (Follmer et al., 2021; infas 360 GmbH, 2022a, b). Based on the resulting information, the subcategories were ordinally sorted within their supercategories by their stringency. Corresponding to their rank placement, each subcategory was assigned a numerical rank value. If the information was missing, the respective subcategory received the value 0. Since different numbers of subcategories per supercategory existed, the theoretical maximum rank values varied. To ensure the comparability between the supercategories, infas scaled all rank values within a supercategory to a sub-index from 1 to 100. Subsequently, for each day and district, the highest rank value for each supercategory was determined to calculate the aggregated mean stringency index for the district and subsequently for the federal states.

We matched the stringency index on the district level to the 258 municipalities included in the FReDA sample. Since some small municipalities can be part of the same district, we had 228 NUTS-3 units in our analysis, which also is the level where the restrictions were implemented. Then, we assigned the respondents their respective value of the stringency index according to the day of their interview. To ensure the interpretability of our results, we standardized the stringency index for all

[1] https://www.corona-datenplattform.de/

[2] BSG-WP-2020/032 Version 12.0 https://www.bsg.ox.ac.uk/research/publications/variation-government-responses-covid-19

models. As an exogenous measure for exposure to COVID-19 restrictions, the data can be considered as a natural experiment to investigate the impact of the COVID-19 restrictions on life satisfaction within different German regions.

Perceived Pandemic Burden As a counterpart to the objective exposure to COVID-19 restrictions measured by the stringency index, we also considered a subjective evaluation of the pandemic situation by deploying the "subjectively" perceived pandemic burden. Respondents could evaluate their "experiences during the COVID-19 pandemic so far" on a 5-point Likert-scale ranging from "strongly disagree" (1) to "strongly agree" (5) based on the following statement: "This period has strongly affected me personally in a negative way." This question provided a summary judgement about the subjective burden that respondents experienced. Thus, we can compare the "subjective" perceived pandemic burden with "objective" exposure to COVID-19 restrictions.

Conrols In addition to the two main independent variables for the pandemic, we included several individual characteristics in the models to account for any unobserved heterogeneity. First, we added the standardized *age* of respondents to all the models, since previous findings indicated that particularly young individuals experienced strong limitations in their mental health, especially regarding the dimension of depressiveness (Alt et al., 2021; Naumann et al., 2021). Based on the International Standard Classification of Education (ISCED), we coded the *educational level* into three categories. The ISCED codes primary and lower secondary education as "low" (1), whereas "middle" (2) includes the upper secondary and post-secondary non-tertiary education. Bachelor's, master's, doctorate, or equivalent levels are coded as a "high" (3) educational level. The *subjective economic situation* ("A household may have different sources of income and more than one household member may contribute to it. Thinking of your household's total monthly income, is your household able to make ends meet?") ranges from "with great difficulty" (1) to "very easily" (6). Furthermore, to control for migration status, we included whether respondents were "born in Germany" (0) or "not born in Germany" (1). In addition, to account for regional differences, we considered whether respondents were currently "living in West Germany" (0) or "living in East Germany" (1).

Relationship status was included in the models using the four categories "single" (1) "partnership and living apart" (2), "cohabiting" (3), and "married" (4), and singles served as the reference category. As a further possible confounder for life satisfaction, we introduced the respondent's *current situation* into all the models. Using "employed" (1) as the reference category, we differentiated the categories "self-employed" (2) "unemployed" (3), "parental leave" (4), "in education" (5), and "other" (0). Last, we added the *number of children* living in the same household in the analyses, differentiating between "no children" (0), "1 child" (1), "2 children" (2), and "3 and more children" (3). For the full sample, we used "no children" (0) as the reference group, and for the sub-group models for fathers and mothers, we used "1 child" (1) as the reference group.

For descriptive statistics for all the variables, see the Online Appendix, Table A2.

Method

We started with a descriptive analysis for trends and regional differences in life satisfaction, the exposure to COVID-19 restrictions index, and the perceived pandemic burden. To accomplish this, we aggregated values by date (83 days of fieldwork) and federal state (16 NUTS-1 units), and plotted these values (due to privacy issues, we could not plot maps at the NUTS-3 level).

Next, to distinguish variation across time and by regional level, we conducted variance decompositions for life satisfaction and our two main independent variables. We estimated three cross-nested "empty" multilevel models in which individuals were clustered within NUTS-3 units and within days. Subsequently, we calculated the intraclass correlation coefficient (ICC). Thus, we obtained the proportion of the variance that is explained by the respective contexts. Like other correlation measures, the ICC ranges from 0 to 1, were 0 means that there is no variance between contexts (Leyland & Groenewegen, 2014; Lorah, 2018). Since our analysis did not reveal any meaningful regional or temporal differences in life satisfaction, we simplified the subsequent multivariate models and estimated OLS-regressions with non-nested clustered standard errors (NUTS-3 units, days). In a first model, we tested the effect of the "objective" COVID-19 restrictions on life satisfaction for the entire sample (m1). In a second model, we added the "subjective" pandemic burden (m2). To assess whether families or mothers suffered more from the pandemic, we estimated a series of interaction effects of the perceived pandemic burden with respect to gender (m3), relationship status (m4), and number of children (m5). Next, we analyzed sub-groups and estimated distinct regression models for mothers (m6), childless women (m7), fathers (m8), and childless men (m9). Again, we estimated the interaction effects of the perceived pandemic burden regarding relationship status (m10-13) and number of children (m14-15).

To facilitate interpretation, before estimating our models, we z-standardized the variables of age, income, exposure to COVID-19 restriction, and perceived pandemic burden to a mean of 0 and a standard deviation of 1. Thus, the continuous and ordinal variables can be interpreted as a one unit increase in life satisfaction associated with a one standard deviation increase in the explanatory variable, holding all the other variables constant. Regarding the categorical explanatory variables, the coefficients reflect a one unit increase in life satisfaction when the variable switches from zero to one. To further ease the interpretation of substantive results, we plotted the average marginal effects (see Online Appendix, Tables A3–A5).

Robustness

As additional tests, we re-estimated all the models as OLS regressions with date and NUTS-3 fixed-effects (m16-30), finding all the reported results to be robust (see Online Appendix, Tables A6–A8). Furthermore, we re-estimated all the models as ordered logistic regressions (m31-45), also finding the reported results to be robust against this change of model type (see Online Appendix, Tables A9–A11). Additionally, we estimated a series of interaction effects of exposure to COVID-19

restrictions omitting the perceived pandemic burden with respect to gender (m46), relationship status (m47), and number of children (m48), but do not find the effects to differ from our findings reported in the main text (see Online Appendix, Table A12). In a next step, we analyzed the sub-groups without the perceived pandemic burden (see Online Appendix, Table A13). We did not find an effect of exposure to COVID-19 restrictions on life satisfaction for mothers (m49), childless women (m50), fathers (m51), and childless men (m52). Finally, we estimated all models again without the control variables – including only gender, relationship status, number of children, exposure to COVID-19 restrictions and perceived pandemic burden – and found the results to be robust (see Online Appendix, m53-m67 in Tables A14–A17).

Results

We begin with descriptions of the regional and temporal differences in general life satisfaction, respondents' exposure to COVID-19 restrictions, and their perceived pandemic burden. The first row of Fig. 1 shows average life satisfaction by NUTS-1 level and by day of the interview. Among the federal states in Germany, we did not observe any meaningful differences in life satisfaction for our sample aged 18–49. Indeed, the average life satisfaction in the lowest scoring state Thuringia (6.66) was only slightly below the highest scoring state Mecklenburg-Vorpommern (6.96). On the top right, we plotted the evolution of life satisfaction on the day of the interview where day 1 corresponds to April 8, 2021, and day 83 to June 29, 2021. We did not find any indication that average life satisfaction changed during that time. When interpreting these results, it is important to consider that most of the interviews were conducted early after the field start of FReDA. The timing of the survey also is relevant regarding the observable variations in average life satisfaction from day 40 onwards, findings that are based on information from about 250 interviews (see underlying histogram, Fig. 1).

In contrast to these null findings of average life satisfaction, the findings of average exposure to local COVID-19 restrictions vary strongly by region and date. From November 2020 until May 2021, Germany was in its second lockdown with its strictest COVID-19 restrictions that were eased by the end of April onwards. This easing of local COVID-19 restrictions also is reflected in our data on the average exposure to COVID-19 restrictions at the district level over time (middle row, right, Fig. 1), where restrictions were lifted notably after the April 27. This easing trend was a response to the "Law for the Protection of the Population in the Event of an Epidemic Situation of National Significance" introduced on April 24, 2021. This law established new common thresholds for contact restrictions at the district level based on 7-day incidence rates of newly infected individuals. Restrictions were further lifted after 7-day incidence rates dramatically fell during May and June of 2021 (see Online Appendix, Figures A1 and A2). Furthermore, Fig. 1 (middle row, left) shows large regional differences in the exposure to COVID-19 restrictions. Whereas individuals in northern states (except for

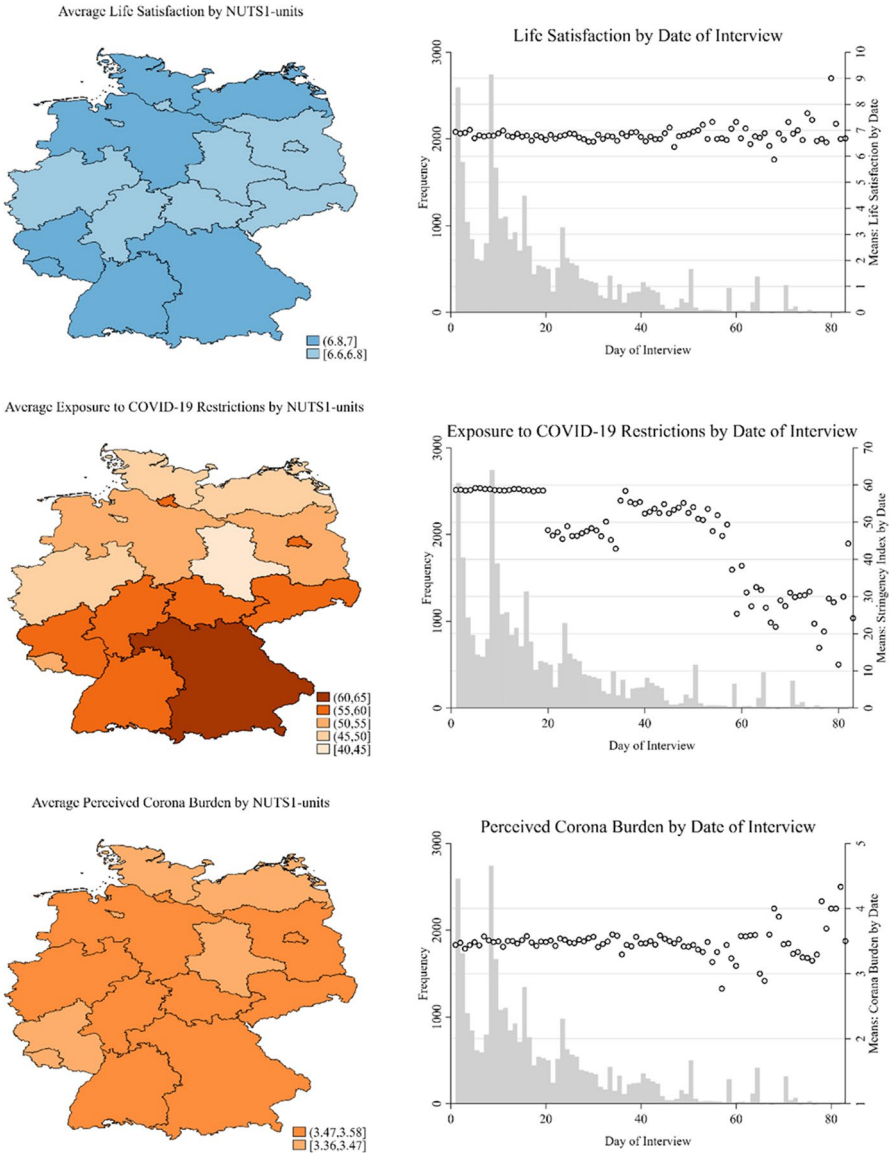

Fig. 1 Life satisfaction, respondent's exposure to COVID-19 restrictions, and perceived pandemic burden by German NUTS-1 levels and date of interview. Notes: Variable means by NUTS-1 levels ($n = 16$) and day of interview ($n = 83$); number of respondents = 32,258. *Source*: FReDA v1.0.0 (Bujard et al., 2022) and infas 360 GmbH (2022b), own calculations

the city-states of Hamburg and Berlin) experienced fewer COVID-19 restrictions, individuals in southern states underwent greater COVID-19 restrictions.

However, neither the lifting of COVID-19 restrictions nor regional differences appear to directly translate into aggregate differences in the perception of the

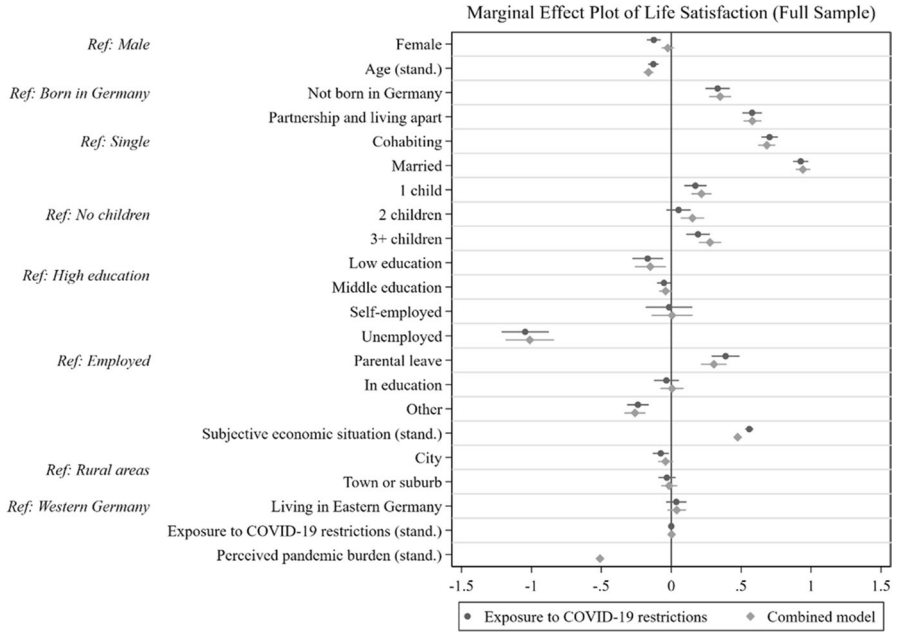

Fig. 2 Average marginal effects of stepwise OLS-regression on life satisfaction. Notes: Based on results from regression models with non-nested clustered standard errrors (NUTS-3 units, days) m1 and m2 in Table A3 in the Online Appendix. The variables "age", "can make ends meet", "exposure to COVID-19 restrictions", and "perceived pandemic burden" are standardized. Lines represent 95% confidence intervals. $N = 32{,}258$ respondents. Exposure to COVID-19 restrictions: adjusted-R-squared = 0.15. Combined model: adjusted-R-squared = 0.22. *Source*: FReDA v1.0.0 (Bujard et al., 2022) infas 360 GmbH (2022b), own calculations

"subjective" pandemic burden, which was basically uniform across Germany and constant during the time under investigation (bottom row, Fig. 1).

The Fig. 1 initial descriptive findings are confirmed in Table 1 by the variance decomposition of life satisfaction, exposure to COVID-19 restrictions, and individuals' perceived pandemic burden. Using this analysis, we no longer were restricted by privacy issues and could distinguish between NUTS-3 levels in which the COVID-19 restrictions were implemented at that time. The results of the "empty" multilevel models show neither meaningful temporal nor regional variation in life satisfaction or in respondents' perceived pandemic burden. However, a substantial variation existed regarding the measure of exposure to COVID-19 restrictions: 53.05% of the variation can be attributed to time and 13.73% to the differences between the NUTS-3 units, which suggests that changes in respondents' exposure to COVID-19 restrictions were much larger within their counties over time than the (persistent) differences between counties.

So far, our results do not indicate that (a) differences in COVID-19 restrictions over time were related to an immediate change in the level of life satisfaction or a change in the perceived pandemic burden. We also did not find that (b) regional

Table 1 Variance decomposition of life satisfaction, respondent's exposure to COVID-19 restrictions, and perceived pandemic burden by region and date

	Life satisfaction	Exposure to COVID-19 restrictions	Perceived pandemic burden
ICC NUTS-3	0.002	0.137	0.001
ICC Date	0.001	0.531	0.000

Notes: Based on cross-nested "empty" models where respondents ($n = 32{,}258$) are clustered within NUTS-3 levels ($n = 228$) and within days ($n = 83$). ICC = Intraclass-Correlation Coefficient

Source: FReDA v1.0.0 (Bujard et al., 2022) and infas 360 GmbH (2022b), own calculations

differences in COVID-19 restrictions were associated with life satisfaction or the perceived pandemic burden across counties for the time under consideration. Therefore, our further analyses will focus on the differences among respondents as a third source of variation.

Figure 2 provides the results from the stepwise linear regression models on life satisfaction estimated from the full sample. Regarding the variable exposure to COVID-19 restrictions, we did not find a relationship with life satisfaction at the individual level (m1, m2). In contrast, respondents perceived that the pandemic burden was strongly related to lower levels of life satisfaction (m2). In this model, respondents perceived pandemic burden was the most powerful antecedent of life satisfaction, which was similar in effect size to respondents' subjective economic situation. Holding all other variables at their means, on an 11-point scale, the predicted difference in life satisfaction between a person who did not feel burdened by COVID-19 (minimum value) and those who felt strongly limited by COVID-19 (maximum value) is about 1.81 points.

Figure 3 plots a series of interaction effects of the perceived pandemic burden with gender, relationship status, and number of children. Gender produced a significant difference—the negative effects of the perceived pandemic burden were more pronounced for women than men. Overall, the interaction of relationship status and perceived pandemic burden was not clear. Although the effect of the perceived pandemic burden was significantly stronger for married individuals than for singles or individuals who were cohabitating with their partner (top row, on the right), the effect of the perceived pandemic burden did not differ for individuals in partnerships without a common household and married individuals. Finally, regarding the perceived pandemic burden and number of children, a significant and substantive relationship existed: depressing effects of the perceived pandemic burden on life satisfaction were more pronounced for individuals with more children (bottom row).

Figure 4 shows the differences between the various sub-groups, and estimates distinct models for fathers, mothers, childless women, and childless men. Again, we did not find any effects using the exogenous measure of COVID-19 restrictions. Nevertheless, we found strong relationships between perceived pandemic burden and life satisfaction—similar in size to the full sample—with respect to fathers, childless men, and childless women. We also found that this negative relationship

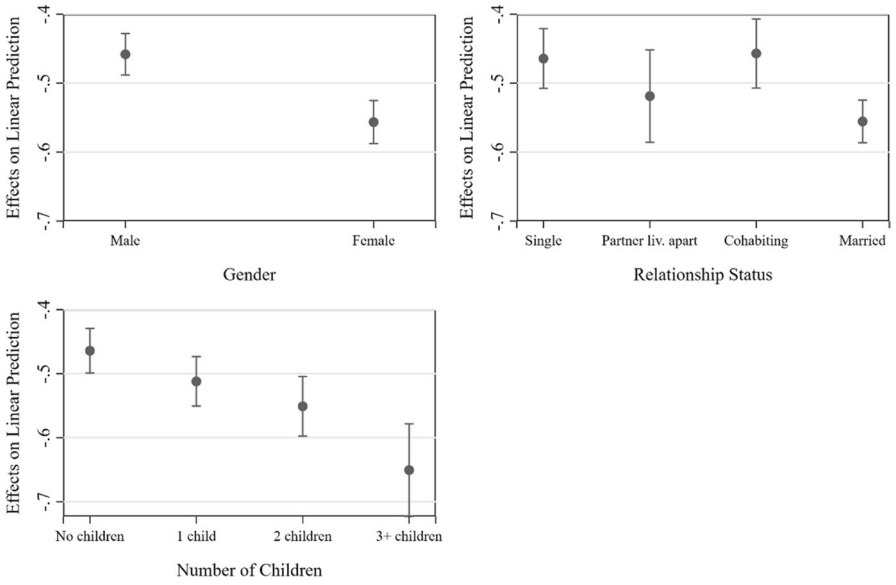

Fig. 3 Average marginal effect of perceived pandemic burden with 95% CIs by gender, relationship status, and number of children. *Notes:* Based on results from regression models with non-nested clustered standard errrors (NUTS-3 units, days) m3-m5 in Table A3 in the Online Appendix. Lines represent 95% confidence intervals. $N = 32{,}258$ respondents. *Source*: FReDA v1.0.0 (Bujard et al., 2022) and infas 360 GmbH (2022b), own calculations

was even more pronounced for mothers: on the 11-point life satisfaction scale, the predicted difference in life satisfaction between a mother who did not feel burdened by COVID-19 (minimum value) and a mother who felt strongly limited by COVID-19 (maximum value) is about 2.23-points. Thus, our results strongly indicate that regarding differences in the relationship of life satisfaction and perceived pandemic burden, gender per se is not the cause, but rather being or not being a mother.

Figure 5 provides the interaction effects of perceived pandemic burden and relationship status by referring to the sub-groups of mothers, fathers, and childless women and men introduced in Fig. 4. Regarding mothers and fathers, we also estimated interaction terms for their number of children (bottom row). However, as shown in the top and middle rows, the interaction terms of relationship status and perceived pandemic burden were insignificant for all sub-groups. In contrast to these findings, we believe that the significant effect of relationship status presented in Fig. 3 might capture the differences for the number of children in our analytical sample: in our dataset, only 13.66% of singles had children, whereas 83.42% of married individuals had children.[3]

The number of children and the pandemic burden on the life satisfaction of mothers and fathers showed substantial and significant effects for mothers: the greater

[3] For the record, 16.78% of individuals with partners living apart had children, and 33.89% of cohabitating individuals had children.

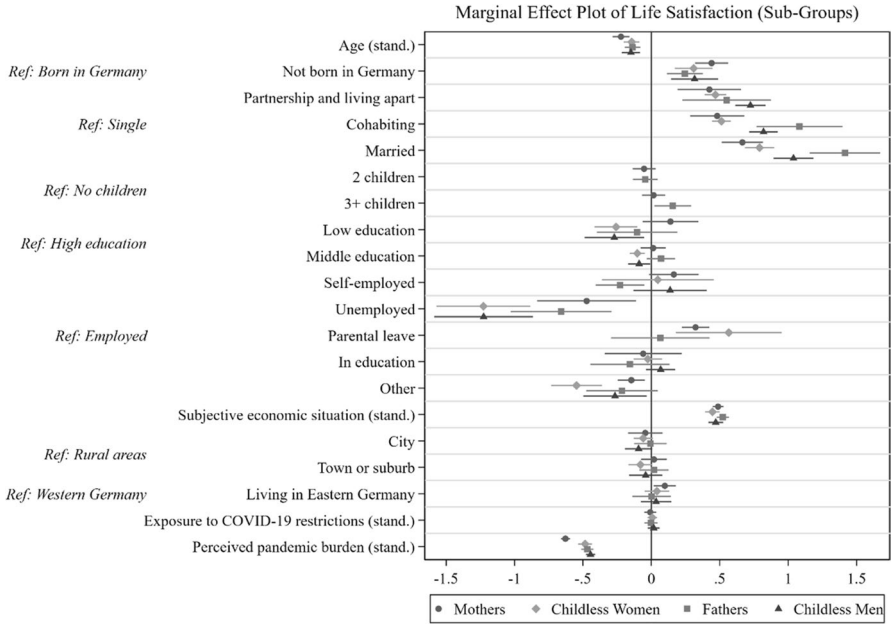

Fig. 4 Average marginal effects of OLS-regressions on life satisfaction by mothers, childless women, fathers, and childless men. *Notes:* Based on results from regression models with non-nested clustered standard errrors (NUTS-3 units, days) m6-m9 in Table A4 in the Online Appendix. The variables "age", "can make ends meet", "exposure to COVID-19 restrictions", and "perceived pandemic burden" are standardized. Lines represent 95% confidence intervals. Mothers: N = 9,265 respondents, adjusted-R-squared = 0.22. Childless women: N = 8,314 respondents, adjusted-R-squared = 0.20. Fathers: 6,528 respondents, adjusted-R-squared = 0.23. Childless men: 8,151 respondents, adjusted-R-squared = 0.21. *Source*: FReDA v1.0.0 (Bujard et al., 2022) and infas 360 GmbH (2022b), own calculations

the number of children living in the household, the larger the negative effect of the perceived pandemic burden on life satisfaction. For fathers, the effect did not vary by the number of children.

Conclusion

Based on representative survey data from the FReDA study and contextual data on COVID-19 restrictions, our study investigated to what extent COVID-19-related NPIs and subjective perceptions about the pandemic situation were associated with individuals' life satisfaction. Our study provides insights on the time of the second COVID-19 lockdown in the spring of 2021 and on the consequences of COVID-19-related restrictions by comparing regional differences within Germany in which NPIs varied substantially in strength and duration.

Consequently, we found that the exposure of individuals to COVID-19 restrictions varied substantially between NUTS-3 units and over time (i.e., the FReDA field time). However, we did not find regional differences in life satisfaction or

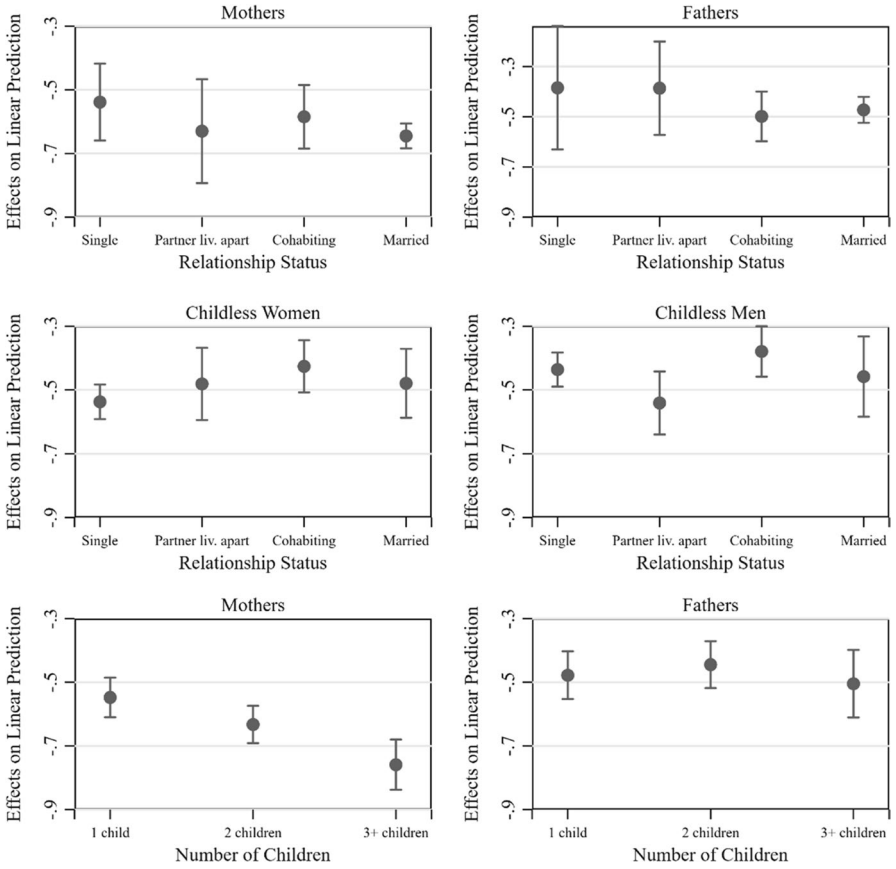

Fig. 5 Average marginal effects of perceived pandemic burden with 95% Cis by relationship status and number of children for sub-groups. *Notes:* Based on results from regression models with non-nested clustered standard errrors (NUTS-3 units, days) m10-m15 in Table A5 in the Online Appendix. Lines represent 95% confidence intervals. *Source*: FReDA v1.0.0 (Bujard et al., 2022) and infas 360 GmbH (2022b), own calculations

differences over time. Also, individuals' perceived pandemic burdens did not vary regionally or over time. These findings show that regional differences and the easing of COVID-19 restrictions were unrelated to levels of life satisfaction at the end of the second lockdown in Germany, since the average life satisfaction was similarly low in all regions, and levels of life satisfaction did not change over time. However, these results are in contrast to the findings of the Huebener et al. (2021) study that showed a variation in life satisfaction in accordance with COVID-19 restrictions during the first lockdown in 2020 in Germany. Although our study did not find an immediate increase in average life satisfaction after the easing of COVID-19 restrictions, future studies may find a delayed increase in the average levels of life satisfaction later in time. Perhaps losses in life satisfaction are realized more quickly during times of crisis than when recovery to the baseline is achieved when

restrictions are eased. The contrast of our findings to those of the first German lockdown (Huebener et al., 2021) also may be explained by our focus on the long lasting COVID-19 restrictions of the "second lockdown" between December 2020 and May 2021—important changes in life satisfaction already may have been realized before our observations began. Nevertheless, in our analysis sample, the average life satisfaction (6.81) was similar to other study findings in Germany, for example, 6.63 in NEPS data from May 2020 (Bittmann, 2022), 6.90 in COMPASS data from 2020 during the first lockdown (Huebener et al., 2021), and 7.2 in SOEP CoV data from the second lockdown in 2021 (Entringer & Kröger, 2021), which raises some doubts about this interpretation. To address this question more thoroughly, multiple measurements of life satisfaction per year by probabilistic surveys are needed, and ideally, the series should start some time before the onset of the pandemic. While we used probabilistic data, we could not address the need of longitudinal data in this study, particularly not regarding pre-pandemic survey data.

The results from our multiple OLS-regression models confirm that exposure to COVID-19 restrictions was not related to life satisfaction. In contrast, in our models, individuals' perceptions of the pandemic as a burden were significantly related to lower levels of life satisfaction, and the effect size of these perceptions was substantial and large compared to other variables. Thus, even though we did not find any meaningful regional or temporal variations in these perceptions, their relationship to life satisfaction was pronounced at the individual-level. Again, it is possible that negative perceptions of the pandemic might have built up in an earlier phase, potentially also as a response to earlier NPIs.

Regarding our third research question, our models with interaction terms with individuals' perceived pandemic burden showed that in particular women and parents had lower levels of life satisfaction. These findings are in line with previous studies that found a gender gap in life satisfaction in Greece (Anastasiou & Duquenne, 2021) and a decline in parents' life satisfaction in Germany (Huebener et al., 2021). Further subgroup analysis shows that perceived pandemic burden reduced the level of life satisfaction of women with children compared to childless women, while the effect on life satisfaction of the perceived pandemic burden is similar between fathers and childless men. This finding is in line with results that have shown significantly lower mental health of mothers compared to fathers in the spring of 2020 in Germany (Hiekel & Kühn, 2022). Our findings highlight that, in particular, mothers' well-being has suffered during the pandemic.

While we relied on a large nationally representative sample of individuals aged 18–49 residing in Germany during the pandemic, our analysis was limited to cross-sectional data. Therefore, we could neither account for within-individual change in life satisfaction compared to pre-pandemic times, nor for individual adaptation processes during the pandemic. Furthermore, our analysis of average life satisfaction over the duration of the field study fell into the easing out phase of COVID-19 restrictions in Germany. At the first glance, this timing might seem disadvantageous since life satisfaction did not recover instantly after restrictions easing. Yet, our analyses show relevant differences in "objective" COVID-19 restrictions between regions. In other words, although COVID-19 measures varied regionally, life satisfaction did not (immediately), which emphasizes the importance of individuals'

perception of the pandemic as a stressful event. Thus, our study shows that subjective perceptions about the pandemic were important to individuals' life satisfaction, whereas the role of the objective strength of COVID-19 restrictions was neglectable.

As our sample lacks individuals aged 50 and older, we can only speculate about correlates in their life satisfaction during the pandemic and their perceptions about the pandemic. However, while our results hint on lower levels in life satisfaction in higher ages, the pandemic might had less stressful effects on older people compared to mothers in our sample. In contrast the fear of getting sick with Corona might be higher among individuals aged 50 and older; a fear that might affect the perception of the pandemic as a burden and, thus, could lead to lower levels in life satisfaction among older individuals.

Overall, our study contributes to the manifold research findings on the consequences of the COVID-19 pandemic on the well-being of the population by incorporating the regional variations of "objective" COVID-19 restrictions and a subjective evaluation of the pandemic situation. While the theoretical concept of *subjective well-being* combines positive and negative affect, as well as subjective life satisfaction, in our study, we only assessed subjective life satisfaction. Future research could enlarge our findings by assessing all three dimensions of subjective well-being. In addition, it would be interesting to assess when and under what conditions individual life satisfaction recovers from low levels.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11482-023-10249-x.

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Data Availability The survey data used in this study in the analysis (The German Family Demography Panel Study – FReDA, data from W1R, 2021, https://doi.org/10.4232/1.13745) is available from GESIS Search (https://search.gesis.org/research_data/ZA7777?doi=10.4232/1.13745). The data on the stringency index is provided by infas 360 GmbH. (https://www.corona-datenplattform.de/dataset/massnahmen index_kreise_pro_tag).

Declarations

Ethics Approval No ethics approval was required, as this study uses survey data from the German Family Demography Panel Study (FReDA), which ensures respondents' anonymity and operates under GDPR.

Consent This study uses survey data from the German Family Demography Panel Study (FReDA), for which informed consent was obtained from all participants.

Conflict of Interest The authors declare that they have no conflict of interest.

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