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The catastrophic effects of natural disasters on social and economic systems are well documented; however, their impacts on individual life satisfaction remain insufficiently understood. This study pioneers a causal analysis of the effects of cyclones on life satisfaction in Australia, leveraging local cyclone exposure as a natural experiment. Drawing on more than two decades of nationally representative panel data, individual fixed-effects models reveal that only the most severe Category 5 events—particularly those occurring in close proximity to residences—significantly reduce overall life satisfaction, as well as satisfaction with community and health. Notably, these severe cyclones exhibit either lasting or delayed adverse effects on satisfaction with employment opportunities, neighbourhood, community, and personal safety. The findings are robust across a range of sensitivity checks, including a falsification test confirming no effect of future cyclones on current life satisfaction, and three randomization tests. Furthermore, these negative impacts are more pronounced among males, younger individuals, and those without prior residential insurance coverage.

Keywords: Natural Disasters; Life Satisfaction; Happiness; Wellbeing; Australia.

JEL classifications: I12; I31; Q54

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1. Introduction

Natural disasters have a profound impact on various facets of society, including social dynamics, health outcomes, and economic stability (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019). As concerns over increasing natural disaster risks intensify (Elsner *et al.* 2008; Fischer *et al.* 2021), there is a corresponding rise in research examining the effects of these events on life satisfaction (Carroll *et al.* 2009; Gunby & Coupé 2023). However, there remains a significant gap in strong causal evidence regarding the influences of natural disasters on various domains of life satisfaction (see Section 2 for a literature review). This underscores the need for more robust studies that can provide a deeper understanding of these complex relationships.

Establishing the causal impact of natural disasters on life satisfaction remains a challenge. Existing studies often rely on cross-sectional individual-level data. These data limitations make it difficult to account for unobserved individual time-invariant factors, such as residential preferences, which may be correlated with both natural disaster exposure and life satisfaction (Dell *et al.* 2014; Botzen *et al.* 2019). This is particularly concerning given prior research suggesting individuals residing in disaster-prone regions tend to have more disadvantaged backgrounds (Currie & Rossin-Slater 2013; Nguyen & Mitrou 2024). Furthermore, much of the current literature relies on disaster exposure measures that are influenced by human behaviour, potentially confounding the estimated effects of natural disasters (Wooldridge 2010). As such, the validity of existing findings hinges on effectively addressing the confounding influence of these unobserved characteristics.

To overcome these limitations, the present study leverages over two decades of nationally representative longitudinal data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, linked to detailed historical cyclone records. By using exogenously measured cyclone exposures as natural experiments and applying individual fixed-effects

models, this study causally identifies the impacts of cyclones on life satisfaction among Australians. It contributes to the existing literature in three important ways.

First, this study provides a novel and comprehensive analysis of the effects of cyclones on life satisfaction in Australia. While cyclones are a significant threat in this nation, no prior study has documented their impact on life satisfaction. A fresh examination is crucial given the catastrophic nature of cyclones, ranking among the most devastating extreme weather events with the potential to inflict widespread disruption and damage (Krichene *et al.* 2023). Understanding the ramifications of cyclones on life satisfaction is imperative for crafting effective policies to support affected populations.

Second, this study is one of a few employing longitudinal individual-level data and exogenously constructed natural disaster exposure measures to examine the effect of natural disasters on life satisfaction (refer to Section 2 for a literature review). Specifically, the HILDA dataset permits us to employ an individual fixed-effects model, effectively controlling for unobserved individual time-invariant factors (Dell *et al.* 2014; Botzen *et al.* 2019). Additionally, our study utilizes various cyclone exposure metrics identified exogenously by combining the distance from the individual's residing postcode centroid to the eye of the cyclone and the cyclone category. By incorporating these exogenous measures within the individual fixed-effects framework, our empirical strategy effectively addresses potential biases arising from unobserved individual factors. Moreover, this extensive and long-term panel dataset facilitates an investigation of the dynamic impacts of cyclones on life satisfaction.

Third, our rich longitudinal data facilitates an exceptionally rich heterogeneous analysis. Spanning 23 years and encompassing over 100 cyclones of varying severity, the dataset offers a unique opportunity to explore the differential impact of natural disasters with various levels of severity. As a result, our findings can be generalized to a broader range of cyclones. Moreover, the richness of our linked datasets allows us to explore the impacts of cyclones for

diverse sub-populations, identified by numerous individual, household and regional characteristics. Furthermore, this study considers not only overall life satisfaction, as most prior studies did, but also a comprehensive list of seven life satisfaction domains, including home, community, financial, personal safety and health satisfaction. This comprehensive heterogeneous analysis illuminates the channels through which cyclones influence overall life satisfaction as well as various life satisfaction domains and identifies vulnerable groups and regions for targeted support and resilience-building strategies.

Our study yields three main sets of findings. First, the individual fixed-effects model reveals a substantial decline in overall life satisfaction associated with the most severe Category 5 cyclones, with more pronounced effects for cyclones occurring in closer proximity to residences. These severe cyclones also exert adverse effects on specific satisfaction domains, including community and health satisfaction. Remarkably, the identified impacts of cyclones on life satisfaction parallel, and in some cases exceed, the documented effects of the devastating 2009 Black Saturday Bushfires in Australia (Johnston *et al.* 2021), underscoring the potential for substantial economic and wellbeing losses. Additionally, our findings indicate that the adverse effects of cyclone exposure on satisfaction with employment opportunities, community, neighbourhood, and personal safety either persist over time or may take time to materialise.

Second, our thorough heterogeneous analysis uncovers significant variations in the impacts of cyclones on life satisfaction, depending on diverse factors such as gender, age, prior homeownership, income levels, residential insurance coverage, rural or urban residency, coastal proximity, and community cyclone history. The impacts vary across various life satisfaction domains, with a prevailing trend indicating more pronounced effects among males, younger individuals, and those lacking previous residential insurance.

Third, our findings demonstrate robustness through a series of sensitivity analyses, including a falsification test confirming that future cyclones do not influence current life satisfaction, as well as three randomization tests. Furthermore, the results highlight the importance of accounting for unobserved, time-invariant individual characteristics when estimating the effects of cyclones on life satisfaction.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature, providing context for our research question. Section 3 details the data employed in our analysis. Section 4 presents the empirical models utilized to investigate the relationship between cyclones and life satisfaction. Section 5 then outlines our key findings. To establish the robustness of our results, Section 6 details the various sensitivity tests conducted. Section 7 explores the heterogeneous impacts of cyclones on life satisfaction across different sub-populations. Finally, Section 8 concludes the paper.

2. Literature review

By examining the effects of cyclones on life satisfaction, this study intersects with two distinct lines of research. The first line, a substantial body of work, focuses on the social and economic impacts of natural disasters (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019). Within this domain, our study is closely related to an increasing number of investigations evaluating the effects of cyclones/hurricanes/typhoons on various factors, including economic growth (Hsiang & Jina 2014), migration (Gröger & Zylberberg 2016; Mahajan & Yang 2020; Nguyen & Mitrou 2024; Blonz *et al.* 2025), income (Deryugina *et al.* 2018; Groen *et al.* 2020), health (Currie & Rossin-Slater 2013; Bakkensen & Mendelsohn 2016), or insurance acquisition (Nguyen & Mitrou 2024, 2025c).

Our research also contributes to a rich line of inquiry examining the role of various factors affecting life satisfaction/subjective wellbeing/happiness.[1] These factors include income (Frijters *et al.* 2004), life events (Nguyen *et al.* 2020), pollution (Levinson 2012; Zhang *et al.* 2017), weather (Feddersen *et al.* 2016; Lignier *et al.* 2023), and macroeconomic conditions (Di Tella *et al.* 2003; Nguyen & Duncan 2020). Within this literature, our study is particularly related to a growing number of studies focusing on the effects of natural disasters on life satisfaction.

Appendix Table B1 summarises the literature on natural disasters and life satisfaction. Research in this narrower field has explored the life satisfaction impacts of various types of natural disasters, including droughts (Carroll *et al.* 2009; Lohmann *et al.* 2019; Berlemann & Eurich 2021), floods (Luechinger & Raschky 2009; Sekulova & Van den Bergh 2016; Van Ootegem & Verhofstadt 2016; Hudson *et al.* 2019; Stein & Weisser 2022), wildfires (Kountouris & Remoundou 2011; Johnston *et al.* 2021), hurricanes (Calvo *et al.* 2015; Berlemann 2016), and multiple natural disasters (Ahmadiani & Ferreira 2021; Frijters *et al.* 2023).

Most studies within this literature grapple with one or both of two primary issues, undermining the interpretability of their findings as causal (Dell *et al.* 2014; Botzen *et al.* 2019). The first issue pertains to the utilization of cross-sectional data, which lack the capacity to control for individual unobservable factors that may correlate with both natural disaster exposure and life satisfaction.

The second issue arises from the reliance on natural disaster exposure measures contingent upon human behaviours, which may confound the natural disaster estimates (Wooldridge 2010). Examples of such measures include individuals' self-reported experiences of natural

[1] Life satisfaction, subjective wellbeing and happiness have been used interchangeably in this literature (for reviews, see Frey and Stutzer (2002) or Ferrer-i-Carbonell (2013)).

disasters, employed by studies using them as proxies for direct natural disaster exposure (Calvo *et al.* 2015; Gunby & Coupé 2023). Additionally, some studies classify regions as disaster-affected areas following official declarations (Luechinger & Raschky 2009; Frijters *et al.* 2023). Others have utilized indirect natural disaster exposure measures based on actual damage incurred by such disasters (von Möllendorff & Hirschfeld 2016; Ahmadiani & Ferreira 2021).

Three notable studies utilizing individual panel data and exogenously measured exposure to natural disasters are Rehdanz *et al.* (2015), Johnston *et al.* (2021) and Stein and Weisser (2022). Rehdanz *et al.* (2015) investigate the impact of the tsunami and nuclear accident at Fukushima, Japan, in 2011; Johnston *et al.* (2021) examine the Black Saturday Bushfires in Victoria, Australia, in 2009; and Stein and Weisser (2022) explore the relationship between self-reported flood experiences, exposure to local floods, and wellbeing among Thai and Vietnamese individuals surveyed between 2007 and 2017. All three studies employ panel data and individual fixed-effects models, measuring exposure by the distance between the individual's place of residence and the disaster event.

Building upon the methodologies of these studies, our current research utilizes various cyclone exposure metrics identified exogenously. These metrics combine the distance from the individual's residing postcode centroid to the eye of the cyclone and the cyclone category. As advocated by Dell *et al.* (2014) or Botzen *et al.* (2019), these geophysical or meteorological metrics are independent of human behaviours. By integrating these exogenous measures within the individual fixed-effects framework, our empirical strategy effectively addresses potential biases arising from unobserved individual factors. Consequently, it enables a robust quantification of the causal impacts of cyclones on various life satisfaction domains.

Appendix Table B1 also shows that Australian studies have explored the effects of droughts (Carroll *et al.* 2009), bushfires (Johnston *et al.* 2021) or self-reported weather-related home

damage (Gunby & Coupé 2023) on life satisfaction.[2] However, no study has examined the impact of cyclones on life satisfaction in Australia, a cyclone-prone country. This study thus contributes as the first to explore the effects of cyclones on life satisfaction in Australia.

3. Data and sample

3.1. Data

Our study draws upon two primary data sources. The first dataset originates from the Household, Income and Labour Dynamics in Australia (HILDA) survey (Summerfield *et al.* 2024). This nationally representative survey, initiated in 2001 and conducted annually, tracks individuals in private households over time, providing detailed individual and household-level data, including residential information, health outcomes, and life satisfaction. A notable advantage lies in HILDA's ability to follow individuals who relocate, ensuring the sample's representativeness and facilitating the utilization of an individual fixed effects model to robustly quantify the effects of cyclones on life satisfaction. We utilize the latest release 23 of HILDA, spanning 23 waves from 2001 to 2023.

The second dataset comprises a publicly available historical cyclone database sourced from the Australian Bureau of Meteorology (BOM). This database furnishes comprehensive information regarding tropical cyclones occurring south of the equator within longitudes 90E and 160E (BOM 2025a). For each documented cyclone, it delineates the track (longitude, latitude, and time) and strength measures such as wind speed.

We establish a connection between the two datasets by aligning the cyclone path and timing from the historical database with the individual's residential postcode centroid and interview date from HILDA. We utilize the restricted-access version of the HILDA dataset, which

[2] This study also relates to other research that utilises the same dataset and broadly similar methods to examine the effects of cyclones on residential choices (Nguyen & Mitrou 2024), locus of control (Nguyen & Mitrou 2025b), health insurance uptake (Nguyen & Mitrou 2025c), and the Big Five personality traits (Nguyen & Mitrou 2025a). However, none of these studies exclusively investigate the impacts of cyclones on life satisfaction, as the present study does.

requires a specialized application process and includes postcode-level data, providing the finest geographical granularity available (Summerfield *et al.* 2024). Appendix Figure A1 graphically depicts the cyclone hit map during the study period.

3.2. Cyclone exposure measures

Following the methodology outlined by Nguyen and Mitrou (2025c), we determine an individual's exposure to cyclones within a given year by considering the distance to the cyclone's eye and its category. Initially, we ascertain the closest distance between the individual's residential postcode centroid and the cyclone's eye, where areas directly beneath its path typically experience the severest damage (BOM 2025b). To ensure the analysis remains manageable and informative, we utilize two distance bands - 40 km and 100 km - to assess exposure. A similar approach has been employed in both international and Australian studies (Currie & Rossin-Slater 2013; Henry *et al.* 2020; Nguyen & Mitrou 2025c).

In addition to distance, we gauge exposure to a cyclone by its category, which ranges from 1 (weakest) to 5 (strongest). Specifically, we adopt the BOM's recommended cutoffs to classify a cyclone based on its maximum mean wind speed (BOM 2025b). The respective maximum mean wind speed cutoffs for each cyclone category are as follows (in km/h): Category 1 (≤88), 2 (>88 and ≤117), 3 (>117 and ≤159), 4 (>159 and ≤199), 5 (>199). Other studies have also utilized maximum wind speed to assess cyclone exposure (Currie & Rossin-Slater 2013; Hsiang & Jina 2014). Importantly, as emphasized by Hsiang and Jina (2014), using wind speed thresholds allows for a more flexible examination of potential non-linear effects of cyclone intensity.

To facilitate analysis—given the relative rarity of annual cyclone events—and to enhance clarity and focus in presentation, we aggregate cyclone intensities into three groups: Categories 1–2, Categories 3–4, and Category 5 only. Individuals with no recorded cyclone exposure serve as the comparison group. Each exposure group is then matched with the distance from the

cyclone's path to the centroid of the individual's residential postcode. This approach yields a set of six cyclone exposure variables, each defined by cyclone intensity and proximity to the cyclone eye.

3.3. Outcome variables

This study utilizes an individual's overall satisfaction with their life as the primary measure of subjective well-being. This outcome is derived from the direct question: "All things considered, how satisfied are you with your life?" Respondents select a point on a scale ranging from 0 (completely dissatisfied) to 10 (completely satisfied), with higher scores indicating greater life satisfaction. Beyond the overall life satisfaction indicator, the study explores respondents' satisfaction with other life domains available in the data. These domains are obtained from responses to questions asking the respondents about their satisfaction with their employment opportunity (thereafter called "employment opportunity", applicable only to employed individuals), financial situation ("financial situation"), the home in which they live ("home"), feeling part of their local community ("community"), the neighbourhood in which they live ("neighbourhood"), how safe they feel ("personal safety"), and their health ("health").

The selection of specific life satisfaction domains was informed by their perceived sensitivity to cyclones, as noted in prior research (Currie & Rossin-Slater 2013; Bakkensen & Mendelsohn 2016; Johnston *et al.* 2021).[3] These life satisfaction measures, available in all survey waves, have been widely used in Australian studies across various contexts. (Feddersen *et al.* 2016; Nguyen & Duncan 2020; Nguyen *et al.* 2020; Johnston *et al.* 2021; Gunby & Coupé 2023; Lignier *et al.* 2023). Appendix Table A2 presents the correlation matrix for the key life

[3] The study does not incorporate some other measures due to theoretical or practical limitations. For instance, we do not use another aspect of life satisfaction asking respondents about "the amount of free time that they have" due to a lack of established theoretical and empirical frameworks connecting natural disasters to free time satisfaction (Nguyen *et al.* 2020). Similarly, we do not consider some other aspects of wellbeing such as the respondents' satisfaction about their relationship with partner or children since responses are only available to specific sub-populations (e.g., partnered individuals, parents).

satisfaction variables, revealing positive associations between overall life satisfaction and the individual domain-specific measures. However, the strengths of these associations vary between 0.2 and 0.5, indicating that each life satisfaction domain contributes uniquely to the construct of overall life satisfaction. This supports the rationale for conducting separate investigations of each domain.

3.4. Sample

The paper's unit of analysis is the individual due to the availability of all life satisfaction measures at the individual level. Our baseline analysis is centred on states and territories affected by at least one cyclone during the study period, a restriction that enhances the efficiency of individual fixed effects estimates for exposed individuals. This is because cyclone exposure remains constant over time for those in unaffected regions (Wooldridge 2010). As a result, New South Wales, Queensland, Western Australia, and the Northern Territory constitute our baseline sample.

Furthermore, we stipulate that individuals must be observed at least twice within the study period, as our primary empirical model relies on an individual fixed effects model. We also exclude individuals with missing data on key variables included in the model (see Section 4 for details; Appendix Table A1 provides variable descriptions and summary statistics). By combining these restrictions, the final sample size varies depending on the outcome. For instance, to examine the impact of cyclones on overall life satisfaction, we have a longitudinal sample comprising over 214,000 individual-year observations from more than 22,000 unique individuals across 23 years of data. This represents the largest sample size in the study.

4. Empirical model

Following prior studies that examine the effects of natural disasters using individual-level panel data (Currie & Rossin-Slater 2013; Henry *et al.* 2020; Stein & Weisser 2022; Nguyen & Mitrou

2025c), we employ an individual fixed effects (FE) model to examine the effects of cyclones on life satisfaction outcome Y for individual i at time t:

$$Y_{it} = \alpha + \sum_{L=1}^{k} [Z_{i(t-L)}\boldsymbol{\beta}_L] + X_{it}\boldsymbol{\gamma} + \lambda_t + M_{it} + \delta_i + \varepsilon_{it} \quad (1)$$

In Equation (1), the key explanatory variable $Z_{i(t-L)}$ captures cyclone exposure, defined as a categorical variable indicating whether individual i experienced a category 1–2, 3–4, or 5 cyclone (with unaffected individuals as the reference group) within their residential postcode during various time windows.

X_{it} represents a set of time-variant explanatory variables. δ_i denotes individual time-invariant unobservable factors, and ε_{it} is the usual random error term. $\alpha, \boldsymbol{\beta}_L$ and $\boldsymbol{\gamma}$ are vectors of parameters to be estimated, where $\boldsymbol{\beta}_L$ represents the vector of primary interest.

We incorporate a minimum number of individual and household-level time-variant variables into X_{it} to mitigate potential confounding effects. These variables encompass the individual's age (and its square), education level, household size, and residency in major cities. Additionally, we address temporal disparities in outcomes by including dummy variables for survey month (M_{it}) and year (λ_t) separately. Regional discrepancies are accounted for through the inclusion of state/territory dummy variables in Equation (1). Furthermore, we account for local socio-economic conditions that may influence individual behaviour by incorporating regional unemployment rates and the Socio-Economic Indexes for Areas (SEIFA).

We employ an individual FE regression to account for individual heterogeneity, including residential preferences, in Equation (1). This approach is crucial as it enables us to control for individual unobservable time-invariant factors, which is particularly relevant given findings suggesting that areas more prone to natural disasters tend to exhibit higher levels of disadvantage (Dell *et al.* 2014; Botzen *et al.* 2019). Our estimates of the cyclone impact ($\boldsymbol{\beta}_L$)

are derived from yearly variations in cyclone occurrences within a postcode for the same individuals. This, coupled with the stochastic nature of cyclone impacts despite spatial clustering and our exogenously identified natural disaster measures, enhances the strength of causal inference.

We begin by examining the contemporaneous effect of cyclone exposure ($L = 1$ in Equation (1)), defined as exposure occurring within the 12 months prior to the interview date, on life satisfaction, which is measured at the time of the survey. We then explore potential lagged effects by including k lags of cyclone exposure in addition to the contemporaneous measure. The optimal number of lags (k) is determined empirically based on the data.

It is crucial to note that discrepancies in survey and cyclone dates may result in individuals residing in the same postcode experiencing varying degrees of cyclone exposure from the same cyclone within the same survey year (refer to Appendix Figure A2 for the distribution of survey and cyclone timing).[4, 5] This synchronization of survey dates with cyclone occurrences bolsters identification assumptions. To address potential serial correlation issues, we cluster standard errors at the individual level, given that the treatment varies for the same individual over time (Cameron & Miller 2015). As a robustness check, we also present results with standard errors clustered at the postcode level or with additional postcode fixed effects, which yield largely similar findings.

[4] Appendix Figure A2 displays the distribution of cyclone occurrences and HILDA interview dates. The bulk of HILDA interviews (90%) took place during the concentrated period of August to October. Almost all observed cyclones (95%) transpired within the November-April timeframe throughout the study period.

[5] For illustrative purposes, consider two individuals residing in the same postcode who are surveyed one month apart within the same survey wave (e.g., one in October 2020 and the other in November 2020). If a cyclone occurred in October 2020, this difference in survey timing would affect the measurement of both life satisfaction outcomes and cyclone exposure. Since life satisfaction is recorded at the time of the survey, and cyclone exposure is defined based on the 12 months preceding the survey date, the first individual would be classified as exposed to the cyclone in the 2020 survey year, while the second would not. As detailed in Section 3, we use the exact HILDA interview dates and cyclone occurrence dates to determine exposure status for each individual. This computationally intensive matching procedure enhances the robustness of our identification strategy by exploiting exogenous temporal variation in cyclone exposure within individuals over time.

5. Results

5.1. Descriptive results

Table 1 presents descriptive statistics for key variables, stratified by cyclone exposure status. Within our final sample, 8,599 individuals from 5,950 unique persons experienced at least one cyclone within a 100 km radius annually, constituting our "treated" group. Although a relatively small proportion of the study population (4.02%) was affected by a cyclone, the substantial number of individuals affected during the study period ensures that we can detect any impact of cyclones on life satisfaction (Wooldridge 2010).[6]

Comparatively, individuals in the "treated" group exhibit distinct sociodemographic characteristics in contrast to the unexposed "control" group. They are statistically significantly younger, possess lower levels of educational attainment, have smaller family units, and predominantly reside in rural areas. Notably, although regions encompassing the "treated" group have lower unemployment rates, they exhibit lower overall socio-economic status, as indicated by lower SEIFA scores. This corroborates previous research (Dell *et al.* 2014; Botzen *et al.* 2019), suggesting that populations vulnerable to natural disasters, as defined by education and socioeconomic disadvantage measured by the SEIFA decile, are disproportionately susceptible to their impacts. Consequently, rigorous methodological approaches that account for individual fixed effects are imperative when investigating the consequences of cyclones.

This table reveals statistically significant ($p < 0.05$) differences in selected life satisfaction outcomes between cyclone-exposed and unaffected individuals. Unexpectedly, exposed individuals report higher levels of overall life satisfaction, as well as in domains of employment

[6] Furthermore, the final column in Appendix Table A1 illustrates that despite the relatively infrequent occurrence of yearly cyclones during the study period, our sample comprises a substantial number of individuals exposed to various cyclones, thus enabling the reliable detection of potential effects. However, it is important to note that the number of individuals affected by more severe cyclones, especially those in closer proximity, is comparatively small. For instance, the minimum count of individuals affected is 662, exposed to a category 5 cyclone within 40 km. Therefore, prudence is advised when interpreting results related to such cyclone exposure measures.

opportunity, financial situation, and personal safety satisfaction. However, as discussed in Section 4, these disparities may not solely reflect direct cyclone impacts but rather pre-existing differences influencing both exposure and satisfaction outcomes. The subsequent analysis addresses this critical issue by employing an individual FE model to control for potentially confounding factors.

5.2. Main regression results

Table 2 presents estimates of the contemporaneous effects of cyclone exposure, disaggregated by two distance bands—40 km and 100 km from the cyclone's eye—based on individual FE regressions.[7] These models control for observable time-varying covariates and unobservable time-invariant individual characteristics. The results indicate significant negative contemporaneous impacts of cyclone exposure on selected life satisfaction measures, particularly in the case of more severe cyclones. For example, all estimates related to exposure to Category 5 cyclones—regardless of distance—show a negative and statistically significant effect (at the 5% level) on overall life satisfaction (see Panel A, Columns 1 and 2 of Table 2). This suggests that individuals exposed to any Category 5 cyclone report significantly lower levels of overall life satisfaction.

The individual FE estimates also reveal a statistically significant (at the 10% level or better) negative relationship between Category 5 cyclone exposure and several life satisfaction domains: community satisfaction (Panel B, Columns 1 and 2), personal safety satisfaction (Panel B, Column 5), and health satisfaction (Panel B, Columns 7 and 8). These results suggest that individuals exposed to Category 5 cyclones experience significant declines in these specific dimensions of life satisfaction.

[7] The estimates for the remaining key explanatory variables, presented in Appendix Table A3, are generally in line with expectations and consistent with findings from prior studies (Nguyen & Duncan 2020; Nguyen *et al.* 2020; Johnston *et al.* 2021).

In contrast, the estimate for exposure to Category 1–4 cyclones within 100 km of the cyclone's eye on community satisfaction is positive and statistically significant at the 5% level (Panel B, Column 2), suggesting that individuals affected by such cyclones report a higher level of community satisfaction. Similarly, positive and statistically significant estimates (at the 5% level) are observed for exposure to Category 3–4 cyclones—regardless of distance—with respect to neighbourhood satisfaction (Panel B, Columns 3 and 4), indicating that individuals affected by these cyclones exhibit greater satisfaction with their neighbourhoods.

This pattern is consistent with anecdotal evidence suggesting that neighbours in Australia often support one another during natural disasters (Longman *et al.* 2023). It also aligns with the findings of Johnston *et al.* (2021), who used the same HILDA dataset to show that individuals affected by the 2009 Black Saturday bushfires in Victoria experienced increased community satisfaction in the aftermath of the disaster. However, such positive associations are only observed for cyclones of Category 4 or lower or for more distant cyclones (as in the case of community satisfaction), whereas exposure to more severe Category 5 cyclones is associated with the opposite effect.

The observed positive impacts of less severe cyclones on community and neighbourhood satisfaction may also contribute to the statistically significant (at the 5% level or better) positive effects of Category 1–2 cyclone exposure on overall life satisfaction (Panel A, Columns 1 and 2). These findings suggest that the impact of cyclone exposure on community, neighbourhood, and overall life satisfaction is contingent on the severity of the event.

Comparing the estimates by distance to the cyclone's eye suggests that the effects are more pronounced—both in terms of absolute magnitude and statistical significance—for individuals closer to the cyclone, particularly in the case of the most severe Category 5 events. For example, the negative impact of Category 5 cyclones on overall life satisfaction, while statistically significant at the 5% level for both distance cutoffs, is approximately 25% larger

in absolute value for individuals residing within 40 km of the cyclone's eye compared to those within 100 km. Similarly, the negative effect on community satisfaction—statistically significant at the 10% level in both cases—is roughly 50% greater for individuals within 40 km than for those within 100 km of a Category 5 cyclone. Furthermore, the impact on personal safety satisfaction is statistically significant only for those within a 40 km radius, where the effect is significant at the 1% level. These patterns underscore the heightened vulnerability of individuals located closer to the eye of the most intense cyclones.

When statistically significant, the estimated effects are substantial in magnitude. For example, the largest observed effect on overall life satisfaction is −0.10, associated with exposure to a Category 5 cyclone within 40 km of its eye. This represents a 1.26% decline relative to the sample mean of overall life satisfaction. Similarly, the largest estimate for personal safety satisfaction is −0.14, also linked to Category 5 cyclone exposure within 40 km, corresponding to a 1.70% decrease relative to the sample mean for this domain. In the case of health satisfaction, the largest estimate is −0.10, again for individuals exposed within 40 km of a Category 5 cyclone's eye, amounting to a 1.38% decline relative to the sample mean of this satisfaction domain.

Overall, the analysis demonstrates that only the most severe Category 5 cyclones substantially reduce overall life satisfaction, with the effects diminishing as the distance from the cyclone eye increases. These severe events also negatively impact specific domains of life satisfaction, including community, personal safety, and health. In contrast, an exception to this pattern is observed among individuals exposed to less severe cyclones, either of lower intensity or at greater distances from their homes, who tend to report higher levels of community, neighbourhood, and overall life satisfaction.

For the sake of focus and brevity, unless otherwise stated, the remainder of this paper concentrates on exposure to the most severe Category 5 cyclones, which have been shown to

exert devastating effects on overall life satisfaction and several specific domains. Similarly, we restrict our analysis to cyclone exposure within 100 km of the cyclone's eye to ensure a sufficiently large number of affected individuals for robust statistical inference.

5.3. Dynamic impacts of cyclones on life satisfaction

Recognizing the potential for delayed effects on life satisfaction, this study examines the dynamic influence of cyclone exposure over time. To capture this temporal dimension, we introduce an additional variable into Equation (1), representing exposure to any Category 5 cyclone within 100 km of its eye in the year preceding the measurement of life satisfaction outcomes (i.e., $k = 2$ in Equation (1)). The estimated coefficients for both contemporaneous and one-year lagged exposure to Category 5 cyclones within 100 km are presented in Panel B of Table 3. Notably, the results for contemporaneous exposure are broadly consistent with those reported in the baseline model (Panel A), and in most cases, exhibit larger absolute effect sizes and greater statistical significance. These findings are encouraging, particularly given the reduced sample size associated with the inclusion of lagged variables, and they reinforce our prior conclusions.

Moreover, several estimates for the one-year lagged exposure variable are negative and statistically significant, suggesting delayed adverse effects of cyclones on certain life satisfaction domains. Specifically, individuals residing within 100 km of the path of a Category 5 cyclone report lower community satisfaction in the subsequent survey wave ($p < 0.1$; Panel B, Column 5), with the magnitude of the estimate comparable to that of contemporaneous exposure. Similarly, the same group reports a significant decline in personal safety satisfaction of 0.09 points ($p < 0.05$; Panel B, Column 7) one year after the event.

Panel C of Table 3 extends this analysis by incorporating two-year lagged exposure variables (i.e., $k = 3$ in Equation (1)). The results suggest continued adverse effects up to two years after exposure for four life satisfaction domains: employment opportunity, community,

neighbourhood, and personal safety satisfaction. The two-year lagged estimates for these outcomes are all negative, statistically significant at least at the 10% level, and sizable, ranging from −0.08 for personal safety satisfaction to −0.14 for employment opportunity satisfaction. Furthermore, the coefficients on contemporaneous and one-year lagged exposure variables remain consistent with those from the earlier specifications, further corroborating the robustness of our findings.

In summary, this dynamic analysis not only reinforces our earlier conclusions regarding the substantial contemporaneous effects of cyclone exposure, but also reveals that the most severe Category 5 cyclones have either persistent or delayed negative impacts on life satisfaction. These effects are evident up to two years post-exposure and are particularly pronounced in domains related to employment opportunities, community, neighbourhood, and personal safety.[8] To our knowledge, this evidence of the delayed impacts of severe cyclones—uncovered through individual-level panel data and dynamic fixed-effects modelling—has not been documented in the existing literature (Calvo *et al.* 2015; Berlemann 2016).

5.4. Discussion

Our findings of a statistically significant impact of category 5 cyclones on selected indicators of life satisfaction align relatively well with some findings in previous research by Johnston *et al.* (2021), who used the same HILDA dataset to document the impacts of the 2009 Black Saturday Bushfires (BSB), one of the worst natural disasters on record in Australia, on life satisfaction.[9] For instance, Johnston *et al.* (2021) found that the BSB reduced overall life satisfaction by between 0.15 and 0.19 points on a 0-10 scale, similar to the scale used in this study. This estimate is slightly higher than our largest estimate of (minus) 0.10 points, observed

[8] Appendix Table A4 presents results from models including three-year lagged exposure variables (i.e., $k = 4$ in Equation (1)), which show no statistically significant effects beyond the two-year lag.
[9] We refrain from comparing our results with those of other studies which use different datasets, life satisfaction measures, or empirical models.

for exposure to a category 5 cyclone within 40 km from homes. Additionally, our highly statistically significant (at the 1% level) estimate of -0.14 points for personal safety satisfaction due to the same cyclone exposure is slightly smaller (in absolute terms) than their marginally statistically significant (at the 10% level) estimate of -0.17 points for the immediate impact of the BSB on this domain.

Johnston *et al.* (2021) further estimated that the decline in life satisfaction attributable to the BSB corresponded to a welfare loss equivalent to as much as 80% of the average annual income of a full-time employed adult in their sample. Applying a similar interpretation, the adverse effects of severe cyclones documented in our study are likely to carry comparably substantial economic and wellbeing implications.

However, unlike Johnston *et al.* (2021), who found no significant effect of the BSB on health satisfaction, our study reveals a substantial negative impact of exposure to a Category 5 cyclone—whether within 40 km or 100 km of individuals' residences—on this domain. Furthermore, while Johnston *et al.* (2021) reported a positive effect of the BSB on community satisfaction, the present study identifies a statistically significant (at the 10% level) negative effect of exposure to a Category 5 cyclone on this analogous domain. Additionally, our study documents substantial and sustained negative impacts on specific life satisfaction domains, contrasting with the absence of significant delayed effects observed in Johnston *et al.* (2021) for the BSB. These differences in findings suggest that cyclones may exert more pronounced adverse effects on certain aspects of life satisfaction and highlight that different types of natural disasters may influence overall life satisfaction and its various domains in distinct ways.

The empirical results thus far indicate that exposure to only the most severe Category 5 cyclones—characterised by maximum wind speeds exceeding 199 km/h—has a statistically significant negative effect on life satisfaction. This finding points to a highly non-linear relationship between cyclone intensity and life satisfaction. It aligns with Nordhaus (2010),

who demonstrated that the macroeconomic impact of U.S. hurricanes is also highly non-linear, with catastrophic effects concentrated above a certain wind speed threshold. It is further consistent with recent U.S. evidence that only the most destructive hurricanes increase migration (Blonz *et al.* 2025), and with Australian evidence that only the most severe Category 5 cyclones lead to increased health insurance uptake (Nguyen & Mitrou 2025c).

6. Robustness checks

To bolster confidence in the reliability of our results, we implemented a series of sampling and specification tests. Due to brevity constraints, we focus on presenting results based on one key concurrent cyclone exposure measure: experiencing a category 5 cyclone within 100 km of the eye. This measure has been shown to have statistically significant negative effects on various life satisfaction domains.

Our initial sampling test involved restricting the regression analysis to individuals residing in Local Government Areas (LGAs) directly impacted by at least one cyclone within 100 km during the study period. This test aimed to address concerns regarding potential limitations in the baseline sample's cyclone exposure variation. The results obtained from this more restricted sample are reported in Panel B1 of Appendix Table A5. Reassuringly, these results closely mirrored the baseline findings (re-reported in Panel A) in terms of both magnitude and statistical significance. To further strengthen the validity of our findings, we also analysed the full sample covering all states and territories (Panel B2) and again observed similar results. In some cases—such as overall life satisfaction and health satisfaction—the estimates are even more pronounced in terms of absolute magnitude or statistical significance.

To enhance the robustness of our model, we conducted seven additional specification checks. First, we incorporated postcode fixed effects to account for unobserved time-invariant factors potentially influencing both cyclone exposure and life satisfaction outcomes within a specific locality (Panel C1). Second, we clustered standard errors at the postcode level to acknowledge

potential spatial correlation within geographic units (Panel C2). Third, we estimated a pooled Ordinary Least Squares (OLS) regression that omits individual fixed effects.[10] The pooled OLS estimates (Panel C3) diverged substantially from the baseline results (Panel A), underscoring the importance of accounting for individual-specific heterogeneity through fixed effects. Fourth, we applied a Random Effects (RE) model, which produced results broadly consistent with those of the FE model (Panel C4). Fifth, we re-estimated the model excluding potentially cyclone-affected time-varying control variables (Panel C5). Sixth and seventh, we conducted separate analyses that incorporated additional time-varying variables potentially co-affected by cyclone exposure, such as non-wage irregular income—which may rise due to disaster-related assistance (Panel C6)—and Short-Form (SF) 36 general health summary (Panel C7) (Nguyen & Mitrou 2025c)). Across all these robustness checks—which lend support to the baseline empirical model employed in this study—the key findings remain consistent, indicating that our results are robust to alternative model specifications.

To further strengthen the causal interpretation of the relationship between cyclone exposure and life satisfaction, we conducted a falsification test. Specifically, we included lagged (one year prior), contemporaneous, and lead (one year ahead) cyclone exposures in an individual FE model. We hypothesized that since future cyclones are unexpected, they should not exert any influence on current life satisfaction when controlling for individual characteristics and past cyclones. The results confirmed this hypothesis (Table 3, Panel D). Specifically, estimates for current and lagged cyclones closely mirrored the baseline findings (Table 3, Panel B), suggesting robust causal inferences. Additionally, the lack of statistical significance for future cyclones reinforces the exogeneity of cyclone exposure.

[10] To address potential confounding effects, we included time-invariant variables, such as gender and migration status, in these specifications.

To further test the robustness of our findings against potential model misspecification, we conduct three randomization tests following the methodology of Hsiang and Jina (2014). First, we randomly assign cyclone exposure observations across the entire sample—referred to as the "whole sample" approach. Second, to account for potential spurious correlations driven by regional trends, we randomly reallocate each individual's cyclone exposure history to another individual while preserving the timing of exposure—termed the "between individual" approach. Third, we randomly reassign the timing of cyclone exposure within each individual, thereby altering only the temporal structure of the data to assess whether time-invariant cross-sectional patterns could generate false correlations—termed the "within individual" approach.

These randomization exercises are implemented using Equation (1), incorporating contemporaneous exposure to Category 5 cyclones within 100 km as the sole exposure variable, with 1000 replications. Figure 1 presents the results for the three life satisfaction outcomes found to be significantly affected by this exposure—overall life satisfaction, community satisfaction, and health satisfaction (all significant at the 5% level or better). Two key findings emerge. First, the distribution of all placebo treatment effects is centred around zero, suggesting that the model specified in Equation (1) does not systematically produce biased estimates. Second, the coefficients derived from the actual data (depicted by solid red lines) consistently fall in the left tail of the distribution, with p-values—calculated as the proportion of randomized estimates less than or equal to the observed estimate—falling below 0.05 in all cases. These results reinforce the validity of our findings, indicating that the observed effects are highly unlikely to have occurred by chance.

By contrast, Appendix Figure A3 presents the randomization results for the remaining life satisfaction outcomes, which were not significantly affected by concurrent cyclone exposure. In these cases, the coefficients derived from the actual data are close to zero, with p-values

exceeding 0.10, thereby confirming the absence of statistically significant contemporaneous effects.

Overall, this comprehensive sensitivity analysis strengthens our confidence in the causal relationship observed between cyclone exposure and life satisfaction. The findings demonstrate resilience to various sampling and specification tests, bolstering the internal and external validity of the study.

7. Heterogeneity

To explore potential mechanisms through which cyclones influence life satisfaction and identify vulnerable sub-populations, we follow Nguyen and Mitrou (2024, 2025c) to employ the individual FE model (i.e., Equation (1)) to estimate effects within distinct groups defined by eight individual, household, or regional characteristics. These characteristics encompass gender (male vs. female), age group (young vs. old, categorized relative to the median population age), homeownership status (renters vs. homeowners), income group (lower income vs. higher income households, defined relative to the median), residential insurance status (insured vs. uninsured)[11], urban/rural residence (major city vs. rural area), distance to the coast (coastal areas vs. inland areas), and whether the individual resides in a historically "cyclone-prone area" (postcode experiencing a cyclone within 100 km in the past 30 years) or a "cyclone-free area".

To mitigate concerns regarding the influence of cyclones on sub-population classification, individuals are categorized based on the values of time-variant variables (excluding age) observed at their first appearance in the sample. For conciseness and illustrative clarity, this section utilizes a singular cyclone exposure indicator (exposure to a category 5 cyclone within

[11] Building on Nguyen and Mitrou (2024), this study classifies individuals as "insured" if their reported annual household expenditure on combined home, contents, and motor vehicle insurance exceeds $1,250 (adjusted to 2010 prices). Conversely, those reporting lower expenditures are categorized as "uninsured". Data on home and contents insurance is sourced from Wave 6 onwards, leveraging responses to the "other insurance (home/contents/motor vehicle)" spending question.

100 km) due to its robust statistical impact in the pooled regression (Table 2) and to ensure adequate sample size for robust heterogeneous analysis across sub-populations. Figure 2 graphically represents subgroup results for the eight life satisfaction domains, with each domain presented in a separate panel. Each panel displays regression estimates visually, depicting both the impact of cyclones and the average life satisfaction within each subgroup. Figure 2 reveals the heterogeneous effects of cyclones across subgroups for various life satisfaction outcomes.

Panel A indicates that cyclones exert a more substantial negative impact on the overall life satisfaction of specific subgroups. This is evidenced by larger (in absolute term) or statistically significant cyclone estimates for males, younger individuals, homeowners, individuals from higher-income households, those without prior residential insurance, and residents of rural, coastal, or cyclone-prone areas. Our finding of a more pronounced negative impact of cyclones on the overall life satisfaction of rural residents aligns with other studies, which also report a heightened negative impact of droughts on rural residents in Australia (Carroll *et al.* 2009) and forest fires in Europe (Kountouris & Remoundou 2011).

Conversely, our finding of more pronounced cyclone effects for males, younger individuals, and individuals from higher-income households contrasts with the evidence by Johnston *et al.* (2021), who used the same HILDA data to demonstrate that bushfires have a more pronounced impact on females, older individuals, and lower-income individuals.[12] These differing impacts of cyclones and bushfires on selected sub-populations suggest that the life satisfaction effects of these two natural disasters are not uniform, underscoring the necessity for separate analyses for each type of natural disaster.

[12] Unfortunately, Johnston *et al.* (2021) did not report heterogeneous results for other life satisfaction domains, preventing a comparison of our findings with theirs.

Panels C and D reveal that while cyclones do not significantly influence financial situation and home satisfaction for the entire population (as shown by the horizontal dashed line representing the cyclone estimate for the whole population), they do reduce these life satisfaction domains for residents of historically cyclone-free areas. This is due to negative and statistically significant cyclone estimates ($p < 0.05$) for these subgroups. Notably, the cyclone estimates are large, accounting for 7% and 6% of the subgroup sample mean of the financial situation and home satisfaction outcome, respectively. This finding aligns with evidence in Nguyen and Mitrou (2024) that residents in historically cyclone-free areas are more likely to relocate following a cyclone. Together, these results suggest that individuals lacking prior experience with extreme weather events may be particularly susceptible to increased vulnerability to damages when encountering them for the first time (Dell *et al.* 2014). This underscores the role of natural disaster readiness in protecting individuals in historically natural disaster-free regions from future disasters.

Panel E suggests that cyclones disproportionately reduce the community satisfaction for males, younger individuals, those without prior residential insurance, and residents of coastal areas or historically cyclone-free areas. Similarly, Panel G reveals that while category 5 cyclones within 100km from homes do not significantly affect overall feelings of personal safety for the entire population, they do reduce this domain for males, younger individuals, and individuals from poorer households. This is indicated by negative and statistically significant cyclone estimates (at least at the 10% level) for these subgroups, suggesting a heightened sense of vulnerability in the aftermath of this cyclone event. Finally, Panel H demonstrates a disproportionate reduction in health satisfaction for males, younger individuals, individuals from higher income households, and residents of rural, inland, or historically cyclone-free areas.

Overall, the aforementioned heterogeneous analysis highlights substantial differential cyclone impacts on life satisfaction among various socio-demographic groups. The extent of this

heterogeneity varies across life satisfaction domains. However, a general finding is that individuals with specific characteristics - males, younger individuals, and those lacking prior residential insurance - are more negatively affected. This underscores the necessity for targeted support policies aimed at building resilience and assisting vulnerable populations. Additionally, the finding that life satisfaction is disproportionately diminished among individuals without prior residential insurance, when viewed alongside evidence presented by Nguyen and Mitrou (2024) that acquiring residential insurance serves as an effective coping mechanism, emphasizes its importance. Together, our findings demonstrate that residential insurance not only mitigates future home-related repair costs but also helps maintain life satisfaction when exposed to future natural disasters.

8. Conclusion

This study presents the first causal investigation of the effects of cyclones on various domains of life satisfaction in Australia. Utilising an individual fixed-effects model and exogenously determined measures of cyclone exposure, the analysis reveals that only the most severe Category 5 cyclones—particularly those occurring in close proximity to residences—significantly reduce overall life satisfaction. These cyclones also have adverse effects on community and health satisfaction. The newly identified impacts on life satisfaction are comparable to, or even exceed, the effects of one of Australia's most devastating natural disasters—the 2009 Black Saturday Bushfires (Johnston *et al.* 2021)—highlighting the potential for substantial economic and wellbeing losses.

Our findings further suggest that severe cyclones have a substantial and lasting adverse impact on satisfaction with employment opportunities, community, neighbourhood, and personal safety. Additionally, the robustness of our results is reinforced through a series of sensitivity analyses, including a falsification test—which confirms that future cyclone exposure does not affect current life satisfaction—as well as three randomization tests. Our extensive

heterogeneous analysis reveals significant differential impacts of cyclones on life satisfaction based on various individual, household, or regional characteristics. This heterogeneity varies across life satisfaction domains, with a general trend showing more pronounced impacts for males, younger individuals, and those lacking prior residential insurance.

The results presented in this study carry important methodological and policy implications. Methodologically, our findings underscore the necessity of accounting for unobserved, time-invariant individual characteristics when estimating the effects of cyclones on life satisfaction, as neglecting these factors may result in biased impact estimates. From a policy perspective, the novel evidence of substantial negative effects of exposure to the most severe Category 5 cyclones on life satisfaction provides critical insights for designing effective interventions and support mechanisms, particularly for disproportionately affected populations.

This study provides novel and robust evidence on the impacts of cyclone exposure on life satisfaction. However, several limitations suggest directions for future research. First, it is beyond the scope of this study to investigate the impact of other natural disasters, such as floods, on life satisfaction. Further research into the distinct impacts of various natural disasters would offer a more comprehensive understanding of their effects on life satisfaction. Second, this study identifies that exposure to less severe cyclones enhances community and neighbourhood satisfaction among affected individuals. The mechanisms through which cyclones improve the sense of community remain unclear. Further research into these potential mechanisms, such as the role of neighbourly assistance during natural disasters, would be beneficial. Additionally, exploring the pathways through which cyclones influence other domains of life satisfaction would be valuable, as collectively, these insights could inform strategies to mitigate the negative impacts of natural disasters on life satisfaction.

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Table 1: Sample means of key variables by cyclone exposure status

	Affected by any cyclone	Unaffected	Affected - Unaffected (1) - (2)
	(1)	(2)	(3)
Age (years)	44.100	44.950	-0.850***
Year 12 [(a)]	0.159	0.152	0.007*
Vocational or Training qualification [(a)]	0.402	0.357	0.045***
Bachelor or higher [(a)]	0.168	0.183	-0.015***
Household size	2.848	2.885	-0.037**
Major city [(a)]	0.345	0.610	-0.266***
Local area unemployment rate (%)	4.993	5.089	-0.096***
Local area SEIFA decile	5.147	5.454	-0.307***
Overall life satisfaction	7.956	7.923	0.033**
Employment opportunity satisfaction	7.149	7.071	0.078***
Financial situation satisfaction	6.695	6.578	0.117***
Home satisfaction	8.006	8.024	-0.017
Community satisfaction	6.753	6.769	-0.016
Neighbourhood satisfaction	7.874	7.885	-0.011
Personal safety satisfaction	8.327	8.229	0.097***
Health satisfaction	7.237	7.264	-0.027
Observations	8,599	205,404	

Notes: Figures are sample means. Estimated sample from the regression of "Overall life satisfaction" as an outcome. [(a)] indicates a binary variable. Tests are performed on the significance of the difference between the sample mean for "affected" individuals (identified as those living in a postcode affected by any cyclone within 100km from the cyclone eye) and "unaffected" individuals (remaining individuals). The symbol * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 2: Concurrent impacts of cyclone exposure on life satisfaction

Distance to cyclone eye:	40km	100km	40km	100km	40km	100km	40km	100km
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:	Overall life satisfaction		Employment opportunity satisfaction		Financial situation satisfaction		Home satisfaction	
Category 1-2	0.12***	0.04**	0.00	0.04	0.07	-0.00	-0.04	-0.02
	[0.04]	[0.02]	[0.07]	[0.04]	[0.06]	[0.03]	[0.05]	[0.03]
Category 3-4	0.02	-0.01	0.05	0.02	-0.07	-0.05	-0.03	-0.01
	[0.03]	[0.02]	[0.05]	[0.04]	[0.04]	[0.03]	[0.04]	[0.03]
Category 5	-0.10**	-0.08**	-0.02	-0.03	-0.02	-0.01	-0.05	-0.02
	[0.04]	[0.03]	[0.08]	[0.06]	[0.06]	[0.05]	[0.06]	[0.04]
Observations	213,951	213,951	168,649	168,649	213,783	213,783	213,891	213,891
No of unique persons	22,302	22,302	20,870	20,870	22,293	22,293	22,303	22,303
Mean dependent variable	7.92	7.92	7.07	7.07	6.58	6.58	8.02	8.02
Panel B:	Community satisfaction		Neighbourhood satisfaction		Personal safety satisfaction		Health satisfaction	
Category 1-2	0.01	0.07**	0.00	0.02	0.00	0.01	0.04	0.01
	[0.06]	[0.03]	[0.05]	[0.03]	[0.05]	[0.02]	[0.05]	[0.02]
Category 3-4	0.05	0.07**	0.08**	0.06**	0.00	0.03	-0.01	-0.00
	[0.04]	[0.03]	[0.04]	[0.02]	[0.03]	[0.02]	[0.04]	[0.02]
Category 5	-0.12*	-0.08*	-0.07	-0.04	-0.14***	-0.04	-0.10*	-0.09**
	[0.06]	[0.05]	[0.06]	[0.05]	[0.05]	[0.04]	[0.05]	[0.04]
Observations	213,546	213,546	213,732	213,732	213,887	213,887	213,972	213,972
No of unique persons	22,287	22,287	22,296	22,296	22,306	22,306	22,306	22,306
Mean dependent variable	6.77	6.77	7.88	7.88	8.23	8.23	7.26	7.26

Notes: Results reported in each column and panel are from a separate individual FE regression. Cyclone exposure is measured by the distance from the cyclone eye, as indicated in the first row of the table. Individuals who were not affected by any cyclone serve as the comparison group. Other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors are clustered at the individual level and reported in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

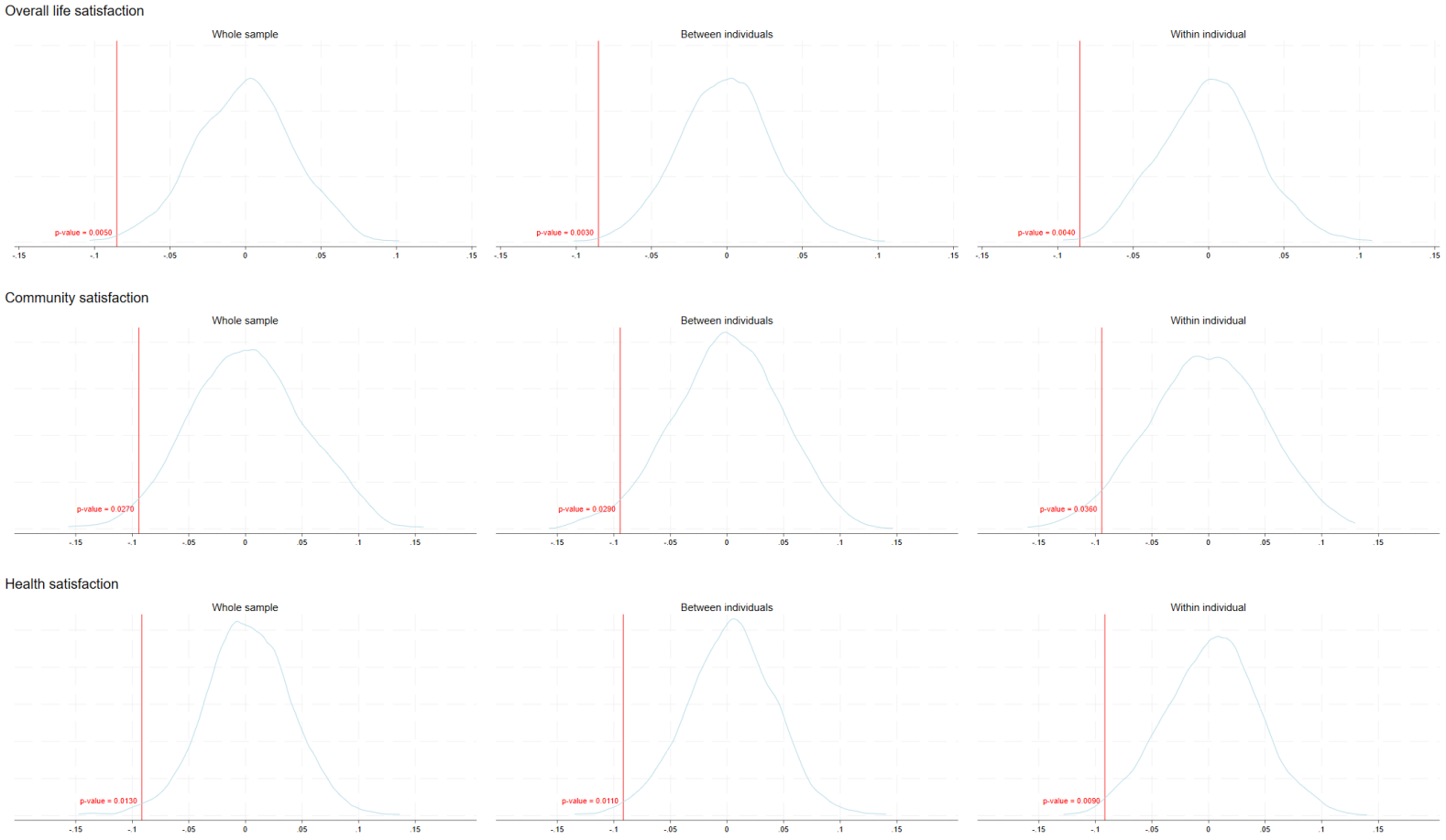
Table 3: Dynamic impacts of category 5 cyclone exposure on life satisfaction

Satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Concurrent								
Current	-0.09**	-0.04	-0.01	-0.01	-0.09**	-0.04	-0.04	-0.09**
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
No of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306
Panel B: One-year lagged								
Current	-0.10***	-0.07	-0.05	-0.04	-0.10**	-0.07	-0.04	-0.11***
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
One-year lagged	0.01	-0.08	-0.02	-0.06	-0.09*	-0.07	-0.09**	-0.01
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]	[0.04]
Observations	188,034	146,505	187,924	187,968	187,689	187,839	187,965	188,045
No of unique persons	18,372	17,017	18,372	18,374	18,365	18,371	18,373	18,375
Panel C: Two-year lagged								
Current	-0.10***	-0.08	-0.06	-0.05	-0.09*	-0.07	-0.04	-0.12***
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
One-year lagged	0.01	-0.10	-0.03	-0.06	-0.10**	-0.07	-0.11***	-0.02
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
Two-year lagged	-0.00	-0.14**	-0.06	-0.02	-0.09*	-0.13***	-0.08**	-0.01
	[0.03]	[0.07]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]	[0.04]
Observations	167,943	129,784	167,868	167,880	167,644	167,765	167,882	167,952
No of unique persons	16,309	15,031	16,309	16,308	16,298	16,300	16,309	16,309

Satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel D: Falsification test								
Current	-0.12***	-0.09	-0.06	-0.06	-0.10*	-0.09*	-0.05	-0.13***
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
One-year lagged	0.00	-0.06	-0.03	-0.05	-0.10**	-0.08*	-0.11***	-0.01
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
One-year lead	-0.05	0.00	-0.02	-0.01	-0.00	-0.03	0.02	-0.04
	[0.03]	[0.07]	[0.06]	[0.05]	[0.06]	[0.05]	[0.04]	[0.04]
Observations	167,895	131,327	167,816	167,833	167,623	167,737	167,830	167,899
No of unique persons	16,317	15,125	16,314	16,315	16,308	16,316	16,316	16,316

Notes: Results reported in each column and panel are from a separate individual FE regression. Cyclone exposure is defined as exposure to any Category 5 cyclone occurring within a 100-kilometre radius of the cyclone's eye. The timing of exposure is indicated in the first column of the table. Other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

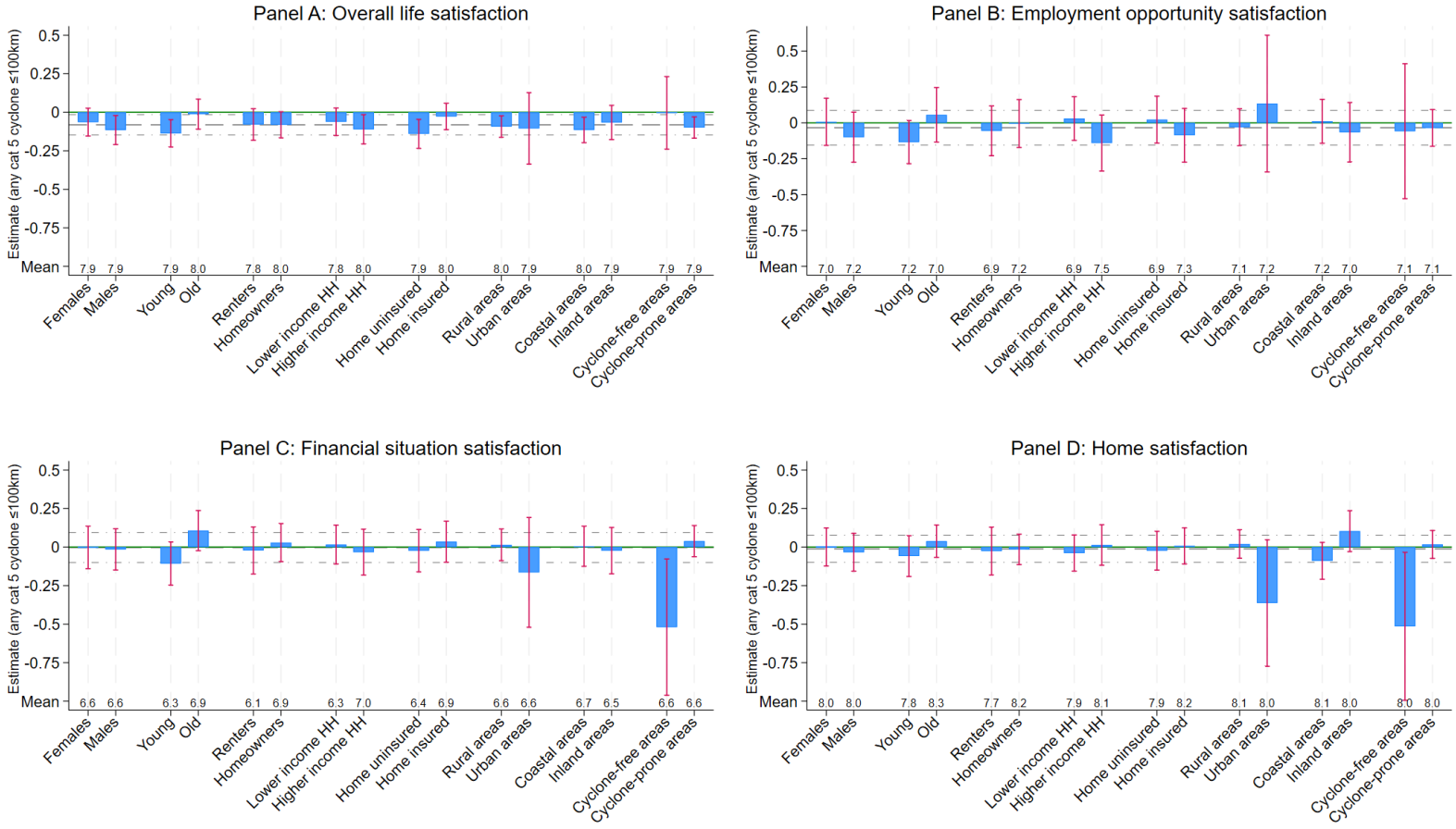
Figure 1: Randomization tests



Notes: This figure depicts the distribution of 1000 regression estimates for the effect of randomly assigned exposure to a category 5 cyclone within 100 km of its eye, derived using Equation (1). We use the Stata command rndm, developed by Hsiang and Jina (2014), to implement the randomization procedure. The vertical red line indicates the observed effect of exposure to a category 5 cyclone within 100 km of its eye, as obtained from real data and Equation (1). The p-value is calculated as the probability that the estimate from the real data is smaller than or equal to the estimates from the randomized data.

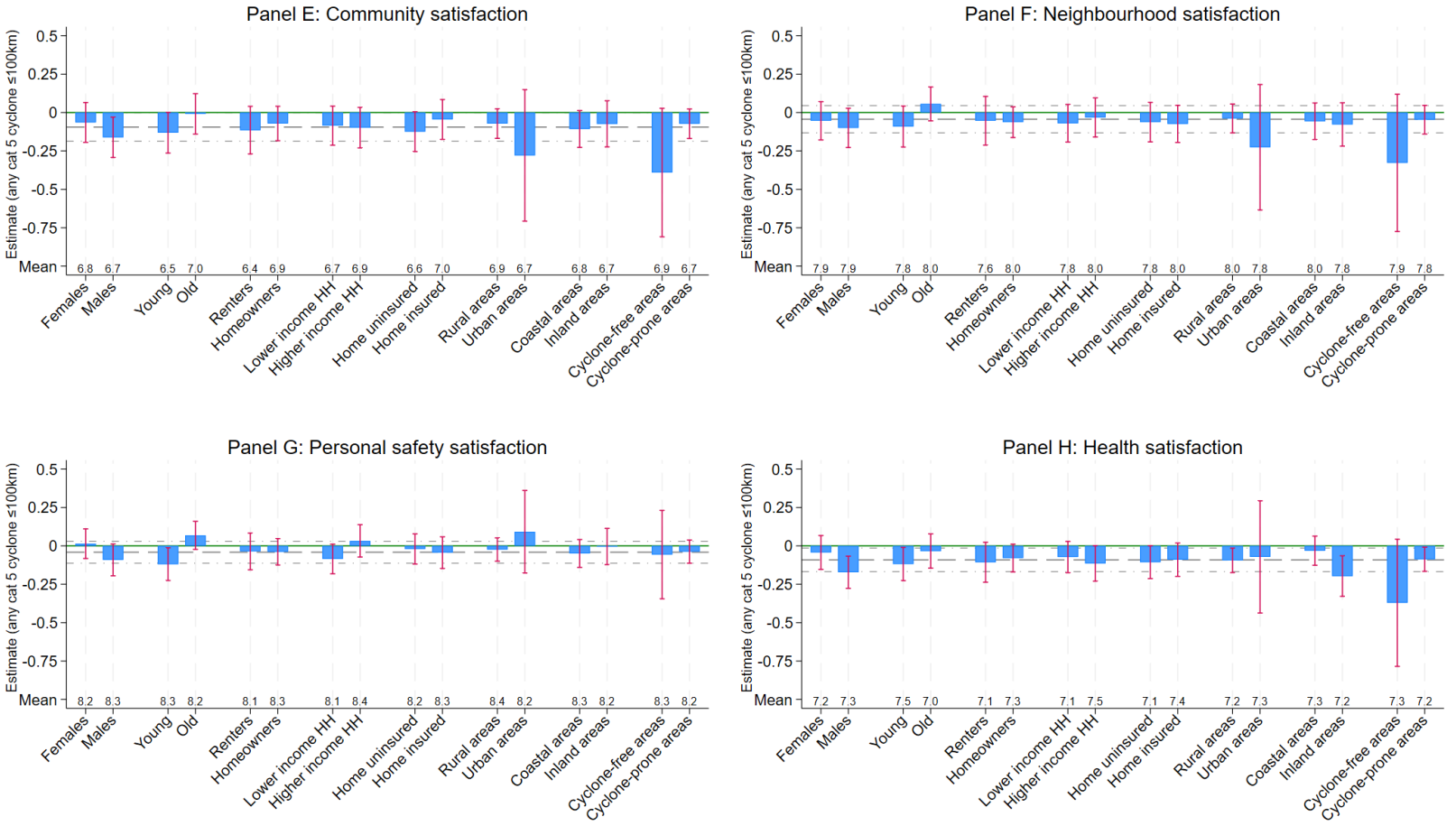
Figure 2: Heterogeneity in the cyclone impact on life satisfaction

Notes: Results for different sub-populations are obtained from a separate FE regression. The dash (short dash dot) horizontal line shows the cyclone exposure coefficient (95%



confidence interval) estimates for the whole population. "Mean" indicates the mean of the dependent variable for each sub-population printed below the bars. Detailed regression results are reported in Appendix Table A6.

Figure 2: Heterogeneity in the cyclone impact on life satisfaction (continued)



Notes: Results for different sub-populations are obtained from a separate FE regression. The dash (short dash dot) horizontal line shows the cyclone exposure coefficient (95% confidence interval) estimates for the whole population. "Mean" indicates the mean of the dependent variable for each sub-population printed below the bars. Detailed regression results are reported in Appendix Table A6.

Online Appendix

for refereeing purposes and to be published online

Appendix Table A1: Variable description and summary statistics

Variable	Description	Mean	Min	Max	Standard deviations		
					Overall	Between	Within
Age (years)	The respondent's age at the survey time (years)	44.92	14.00	101.00	18.89	19.14	5.12
Year 12	Dummy: = 1 if the individual completes Year 12 and zero otherwise	0.15	0.00	1.00	0.36	0.33	0.17
Vocational or Training qualification	Dummy: = 1 if the individual has a vocational or training qualification and zero otherwise	0.36	0.00	1.00	0.48	0.45	0.17
Bachelor or higher	Dummy: = 1 if the individual has a bachelor degree or higher and zero otherwise	0.18	0.00	1.00	0.39	0.36	0.13
Household size	Number of household members	2.88	1.00	17.00	1.49	1.38	0.86
Major city	Dummy variable: = 1 if the individual lives in a major city and zero otherwise	0.60	0.00	1.00	0.49	0.47	0.18
Local area unemployment rate	Yearly unemployment rate at the individual's residing local government area (%)	5.08	2.10	8.10	1.18	0.85	1.05
Local area SEIFA decile	Socio-Economic Indexes for Areas (SEIFA) decile at the individual's residing local government area	5.44	1.00	10.00	2.87	2.67	1.25
Overall life satisfaction	Responses to a question "All things considered, how satisfied are you with your life?"	7.92	0.00	10.00	1.47	1.29	1.00
Employment opportunity satisfaction	Responses to a question asking the respondents about their satisfaction with their employment opportunity	7.07	0.00	10.00	2.36	2.14	1.65
Financial situation satisfaction	Responses to a question asking the respondents about their satisfaction with their financial situation	6.58	0.00	10.00	2.23	1.94	1.52
Home satisfaction	Responses to a question asking the respondents about their satisfaction with the home in which they live	8.02	0.00	10.00	1.79	1.47	1.33
Community satisfaction	Responses to a question asking the respondents about their satisfaction with feeling part of their local community	6.77	0.00	10.00	2.18	1.86	1.53
Neighbourhood satisfaction	Responses to a question asking the respondents about their satisfaction with the neighbourhood in which they live	7.88	0.00	10.00	1.75	1.51	1.27
Personal safety satisfaction	Responses to a question asking the respondents about their satisfaction with how safe they feel	8.23	0.00	10.00	1.59	1.37	1.14
Health satisfaction	Responses to a question asking the respondents about their satisfaction with their health	7.26	0.00	10.00	1.95	1.72	1.23

Notes: Estimated sample from the regression of “Overall life satisfaction” as an outcome.

Appendix Table A1: Variable description and summary statistics (continued)

Variable	Description	Mean	Min	Max	Standard deviations			Number of individuals affected
					Overall	Between	Within	
Any category 1 or 2 cyclone within 40 km	Dummy variable: = 1 if an individual's residential postcode was within 40 km of any category 1 or 2 cyclone's eye last year and zero otherwise	0.004	0.00	1.00	0.07	0.04	0.06	945
Any category 3 or 4 cyclone within 40 km	Dummy variable: = 1 if an individual's residential postcode was within 40 km of any category 3 or 4 cyclone's eye last year and zero otherwise	0.007	0.00	1.00	0.08	0.04	0.08	1,554
Any category 5 cyclone within 40 km	Dummy variable: = 1 if an individual's residential postcode was within 40 km of any category 5 cyclone's eye last year and zero otherwise	0.003	0.00	1.00	0.06	0.03	0.05	662
Any category 1 or 2 cyclone within 100 km	Dummy variable: = 1 if an individual's residential postcode was within 100 km of any category 1 or 2 cyclone's eye last year and zero otherwise	0.017	0.00	1.00	0.13	0.08	0.12	3,599
Any category 3 or 4 cyclone within 100 km	Dummy variable: = 1 if an individual's residential postcode was within 100 km of any category 3 or 4 cyclone's eye last year and zero otherwise	0.018	0.00	1.00	0.13	0.07	0.13	3,804
Any category 5 cyclone within 100 km	Dummy variable: = 1 if an individual's residential postcode was within 100 km of any category 5 cyclone's eye last year and zero otherwise	0.006	0.00	1.00	0.07	0.04	0.07	1,196

Notes: Estimated sample from the regression of “Overall life satisfaction” as an outcome.

Appendix Table A2: Correlation structure among life satisfaction variables

	Life satisfaction	Employment opportunity satisfaction	Financial satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
Life satisfaction	1.00							
Employment opportunity satisfaction	0.38	1.00						
Financial satisfaction	0.46	0.47	1.00					
Home satisfaction	0.44	0.24	0.34	1.00				
Community satisfaction	0.40	0.27	0.31	0.31	1.00			
Neighbourhood satisfaction	0.41	0.26	0.29	0.44	0.51	1.00		
Personal safety satisfaction	0.46	0.31	0.37	0.37	0.38	0.46	1.00	
Health satisfaction	0.49	0.34	0.33	0.23	0.30	0.33	0.34	1.00

Notes: Estimated sample from the regression of "Overall life satisfaction" as an outcome. All correlations are statistically significant at the 1% level.

Appendix Table A3: Remaining results from regressions of concurrent impacts of cyclone exposure on life satisfaction

Life satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	0.01	-0.04	0.11**	0.06	0.06	-0.01	0.04	-0.05
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.04]	[0.04]	[0.04]
Age squared	0.00***	-0.00	0.00***	0.00***	-0.00***	-0.00***	0.00***	0.00
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Year 12 [(a)]	-0.19***	0.18***	-0.22***	-0.24***	-0.46***	-0.22***	-0.22***	-0.31***
	[0.02]	[0.04]	[0.04]	[0.03]	[0.04]	[0.03]	[0.02]	[0.03]
Vocational or training qualification [(a)]	-0.13***	0.38***	-0.00	-0.25***	-0.38***	-0.23***	-0.18***	-0.25***
	[0.03]	[0.05]	[0.04]	[0.04]	[0.04]	[0.03]	[0.03]	[0.03]
Bachelor degree or higher [(a)]	-0.15***	0.42***	0.11**	-0.38***	-0.47***	-0.27***	-0.15***	-0.29***
	[0.03]	[0.05]	[0.05]	[0.04]	[0.05]	[0.04]	[0.03]	[0.04]
Household size	0.02***	-0.02***	-0.00	0.03***	0.08***	0.02***	0.03***	-0.01*
	[0.00]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]	[0.00]
Major city	-0.11***	0.05	-0.12***	-0.30***	-0.44***	-0.46***	-0.27***	-0.12***
	[0.02]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.02]	[0.02]
Local area unemployment rate	-0.01**	-0.10***	-0.05***	0.01	0.01**	0.00	-0.00	-0.00
	[0.00]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]	[0.01]
Local area SEIFA decile	0.01***	0.04***	0.01***	0.04***	0.03***	0.13***	0.03***	0.01***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
No of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306

Notes: Results reported in each column are from a separate individual FE regression. Cyclone exposure is defined as being located within a 100-kilometre radius of the cyclone's eye, and the corresponding results are presented in Table 2. [(a)] indicates "Year 11 or under" as the baseline group. Other explanatory variables include state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Table A4: Dynamic impacts of category 5 cyclone exposure on life satisfaction - Three-year lagged

Satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Current	-0.09**	-0.08	-0.05	-0.06	-0.10*	-0.09*	-0.04	-0.12***
	[0.04]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.04]	[0.05]
One-year lagged	0.00	-0.10	-0.02	-0.06	-0.08	-0.08*	-0.11**	-0.02
	[0.04]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.04]	[0.05]
Two-year lagged	-0.01	-0.13*	-0.04	-0.01	-0.10*	-0.12***	-0.06	-0.02
	[0.04]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
Three-year lagged	-0.00	-0.08	0.01	0.03	-0.01	-0.02	-0.04	0.03
	[0.03]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	150,785	115,600	150,727	150,722	150,516	150,631	150,731	150,798
No of unique persons	14,782	13,637	14,780	14,779	14,776	14,779	14,781	14,782

Notes: Results reported in each column are from a separate individual FE regression. Cyclone exposure is defined as exposure to any Category 5 cyclone occurring within a 100-kilometre radius of the cyclone's eye. The timing of exposure is indicated in the first column of the table. Other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Table A5: Robustness checks for the impacts of cyclone on life satisfaction

Satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Baseline								
Any category 5 cyclone within 100 km	-0.09**	-0.04	-0.01	-0.01	-0.09**	-0.04	-0.04	-0.09**
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
N of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306
Mean of dep. variable	7.92	7.07	6.58	8.02	6.77	7.88	8.23	7.26
Proportion affected (%)	0.56	0.62	0.56	0.56	0.56	0.56	0.56	0.56
Panel B1: Different sample - Including only local government areas with at least one cyclone within 100 km								
Any category 5 cyclone within 100 km	-0.08**	-0.06	0.01	-0.02	-0.07	-0.03	-0.05	-0.10**
	[0.03]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	75,827	60,711	75,755	75,788	75,659	75,745	75,794	75,828
N of unique persons	8,746	8,230	8,743	8,746	8,737	8,745	8,748	8,749
Mean of dep. variable	7.94	7.09	6.52	8.01	6.71	7.88	8.28	7.24
Proportion affected (%)	1.58	1.73	1.58	1.58	1.58	1.58	1.58	1.58
Panel B2: Different sample - Using a sample of all individuals observed in the data								
Any category 5 cyclone within 100 km	-0.09***	-0.05	-0.01	-0.02	-0.11**	-0.08*	-0.04	-0.11***
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	353,128	280,165	352,833	353,004	352,507	352,785	353,039	353,155
N of unique persons	35,218	32,835	35,202	35,219	35,205	35,212	35,224	35,224
Mean of dep. variable	7.93	7.10	6.62	8.02	6.76	7.89	8.25	7.26
Proportion affected (%)	0.34	0.37	0.34	0.34	0.34	0.34	0.34	0.34

Notes: The results presented in each column and panel are based on separate individual FE regression, unless otherwise specified. Unless stated otherwise, other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level, unless indicated otherwise, in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Table A5: Robustness checks for the impacts of cyclone on life satisfaction (continued)

Satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel C1: Different specification - Controlling for postcode dummies								
Any category 5 cyclone within 100 km	-0.08**	-0.03	0.01	0.00	-0.06	-0.02	-0.03	-0.09**
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.04]	[0.04]	[0.04]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
N of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306
Panel C2: Different specification - Clustering at the postcode level								
Any category 5 cyclone within 100 km	-0.09**	-0.04	-0.01	-0.01	-0.09*	-0.04	-0.04	-0.09*
	[0.04]	[0.09]	[0.06]	[0.06]	[0.05]	[0.05]	[0.04]	[0.05]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
N of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306
Panel C3: Different specification - Using pooled cross sectional OLS model								
Any category 5 cyclone within 100 km	-0.08*	-0.14*	0.01	-0.05	-0.10	-0.11**	-0.12***	-0.09
	[0.04]	[0.07]	[0.06]	[0.05]	[0.06]	[0.05]	[0.04]	[0.05]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
Panel C4: Different specification - Using Random Effects model								
Any category 5 cyclone within 100 km	-0.08**	-0.04	-0.00	-0.01	-0.10**	-0.05	-0.05	-0.09**
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
N of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306

Notes: The results presented in each column and panel are based on separate individual FE regression, unless otherwise specified. Unless stated otherwise, other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level, unless indicated otherwise, in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Table A5: Robustness checks for the impacts of cyclone on life satisfaction (continued)

Satisfaction outcome:	Overall life satisfaction	Employment opportunity satisfaction	Financial situation satisfaction	Home satisfaction	Community satisfaction	Neighbourhood satisfaction	Personal safety satisfaction	Health satisfaction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel C5: Different specification - Excluding some time variant variables such as education, household size and major city								
Any category 5 cyclone within 100 km	-0.09***	-0.07	-0.03	-0.01	-0.10**	-0.05	-0.05	-0.09**
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	213,951	168,649	213,783	213,891	213,546	213,732	213,887	213,972
N of unique persons	22,302	20,870	22,293	22,303	22,287	22,296	22,306	22,306
Panel C6: Different specification - Including a time variant variable: non-wage income								
Any category 5 cyclone within 100 km	-0.09**	-0.04	-0.01	-0.01	-0.09**	-0.04	-0.04	-0.09**
	[0.03]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	213,703	168,477	213,541	213,643	213,300	213,485	213,639	213,724
N of unique persons	22,298	20,864	22,289	22,299	22,282	22,292	22,302	22,302
Panel C7: Different specification - Including a time variant variable: SF 36 general health summary								
Any category 5 cyclone within 100 km	-0.08**	-0.02	0.02	0.02	-0.10**	-0.04	0.00	-0.08**
	[0.04]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]
Observations	190,785	149,979	190,693	190,730	190,481	190,617	190,728	190,806
N of unique persons	21,076	19,649	21,069	21,078	21,065	21,071	21,080	21,081

Notes: The results presented in each column and panel are based on separate individual FE regression, unless otherwise specified. Unless stated otherwise, other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level, unless indicated otherwise, in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Table A6: Heterogeneity in the cyclone impact on life satisfaction

Separate by:	Gender		Age		Home ownership		Household income		Residential insurance		Rural/urban		Distance to coast		Locality cyclone history	
	Female	Male	Young	Old	Renter	Owner	Poorer	Richer	Uninsured	Insured	Rural areas	Urban areas	Coastal areas	Inland areas	Cyclone-free areas	Cyclone-prone areas
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Panel A:	Overall life satisfaction															
Any category 5 cyclone within 100 km	-0.07	-0.12**	-0.14***	-0.01	-0.08	-0.08*	-0.06	-0.12**	-0.14***	-0.03	-0.09***	-0.12	-0.12***	-0.07	0.01	-0.10***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.05]	[0.05]	[0.05]	[0.04]	[0.04]	[0.12]	[0.04]	[0.06]	[0.12]	[0.04]
Observations	186,129	166,999	107,818	102,259	77,679	143,203	125,559	95,323	114,834	90,253	81,877	123,210	102,977	102,110	106,028	99,059
N of unique persons	18,134	17,084	12,816	9,091	7,148	11,280	10,136	8,292	8,704	6,374	5,955	9,123	7,580	7,498	7,877	7,201
Mean of dep. variable	7.95	7.90	7.88	7.98	7.75	8.01	7.84	8.03	7.86	8.01	7.99	7.89	7.96	7.89	7.93	7.92
Proportion affected (%)	0.34	0.34	0.61	0.51	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.09
Panel B:	Employment opportunity satisfaction															
Any category 5 cyclone within 100 km	0.00	-0.10	-0.13*	0.05	-0.06	-0.01	0.03	-0.15	0.02	-0.09	-0.03	0.13	0.01	-0.07	-0.06	-0.04
	[0.08]	[0.09]	[0.08]	[0.10]	[0.09]	[0.09]	[0.08]	[0.10]	[0.08]	[0.10]	[0.07]	[0.24]	[0.08]	[0.11]	[0.24]	[0.07]
Observations	142,582	137,583	85,562	78,857	66,466	107,080	105,962	67,584	87,237	72,917	61,235	98,919	80,519	79,635	81,974	78,180
N of unique persons	16,730	16,105	11,233	8,805	6,686	9,954	9,936	6,704	7,650	5,895	5,202	8,343	6,816	6,729	7,024	6,521
Mean of dep. variable	7.04	7.15	7.21	6.96	6.90	7.22	6.87	7.46	6.94	7.32	7.06	7.15	7.20	7.03	7.10	7.13
Proportion affected (%)	0.38	0.37	0.62	0.63	0.71	0.52	0.63	0.53	0.64	0.59	1.51	0.07	0.75	0.48	0.08	1.19
Panel C:	Financial situation satisfaction															
Any category 5 cyclone within 100 km	-0.01	-0.02	-0.11	0.11	-0.03	0.03	0.01	-0.04	-0.03	0.03	0.01	-0.19	0.00	-0.03	-0.50**	0.03
	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.06]	[0.06]	[0.08]	[0.07]	[0.07]	[0.05]	[0.18]	[0.07]	[0.08]	[0.23]	[0.05]
Observations	185,975	166,858	107,711	102,203	77,663	143,071	125,659	95,075	114,693	90,232	81,770	123,155	102,906	102,019	105,965	98,960
N of unique persons	18,123	17,079	12,810	9,092	7,149	11,275	10,147	8,277	8,695	6,374	5,947	9,122	7,576	7,493	7,874	7,195
Mean of dep. variable	6.63	6.60	6.35	6.86	6.08	6.87	6.31	6.97	6.36	6.94	6.58	6.64	6.71	6.51	6.65	6.57
Proportion affected (%)	0.34	0.34	0.61	0.51	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.09
Panel D:	Home satisfaction															
Any category 5 cyclone within 100 km	-0.00	-0.03	-0.06	0.03	-0.03	-0.01	-0.04	0.01	-0.03	0.00	0.02	-0.38*	-0.09	0.10	-0.50**	0.01
	[0.06]	[0.06]	[0.07]	[0.05]	[0.08]	[0.05]	[0.06]	[0.07]	[0.06]	[0.06]	[0.05]	[0.21]	[0.06]	[0.07]	[0.24]	[0.05]
Observations	186,078	166,926	107,783	102,236	77,692	143,141	125,558	95,275	114,786	90,220	81,837	123,169	102,942	102,064	106,008	98,998
N of unique persons	18,136	17,083	12,817	9,093	7,150	11,281	10,139	8,292	8,703	6,373	5,952	9,124	7,579	7,497	7,876	7,200
Mean of dep. variable	8.03	8.00	7.80	8.26	7.66	8.21	7.93	8.12	7.90	8.16	8.06	7.98	8.07	7.96	8.03	7.99
Proportion affected (%)	0.34	0.34	0.61	0.52	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.09

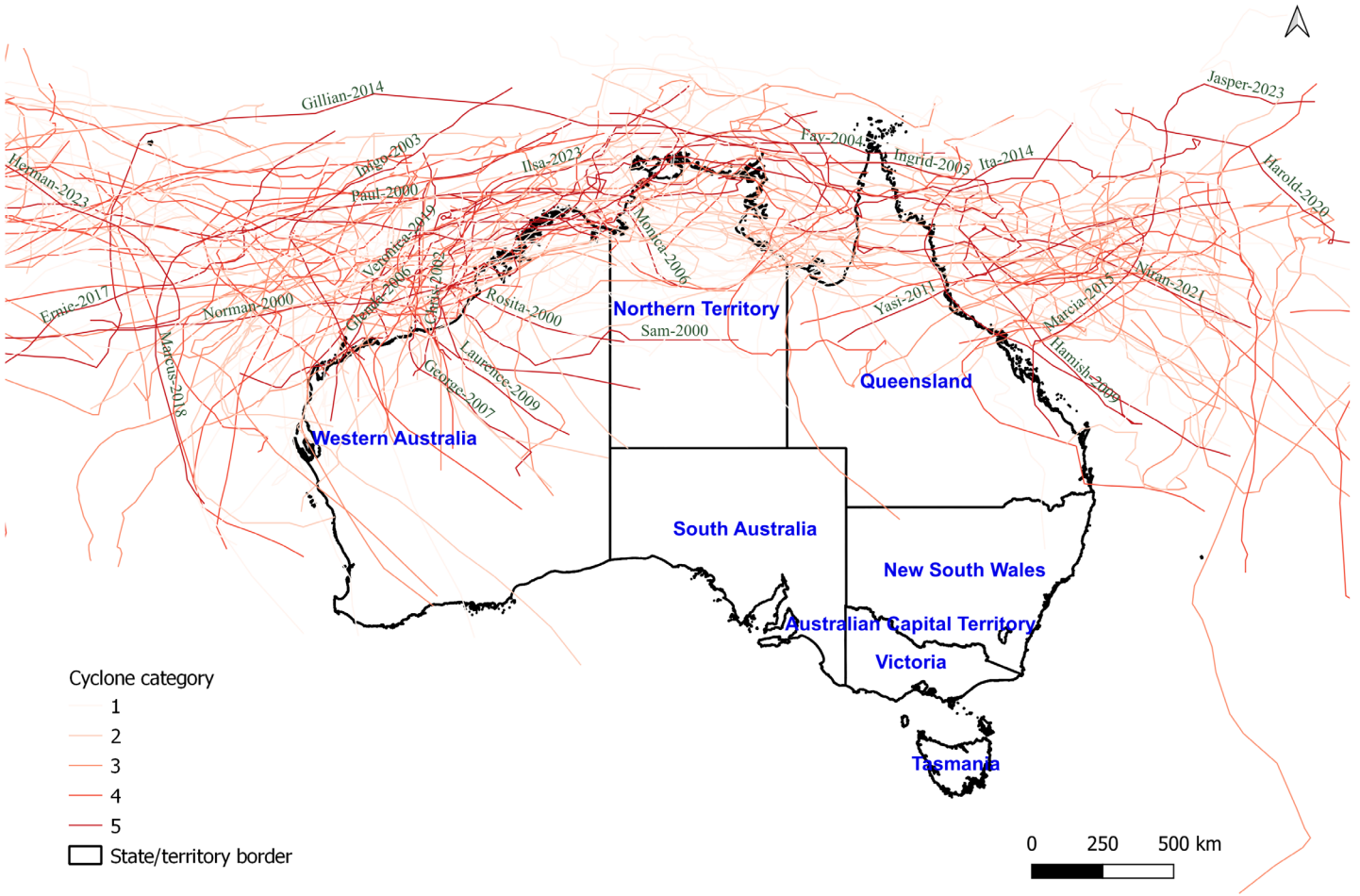
Notes: The results presented in each column and panel are based on a separate FE regression. Other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Table A6: Heterogeneity in the cyclone impact on life satisfaction (continued)

Separate by:	Gender		Age		Home ownership		Household income		Residential insurance		Rural/urban		Distance to coast		Locality cyclone history	
	Female	Male	Young	Old	Renter	Owner	Poorer	Richer	Uninsured	Insured	Rural areas	Urban areas	Coastal areas	Inland areas	Cyclone-free areas	Cyclone-prone areas
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Panel E:	Community satisfaction															
Any category 5 cyclone within 100 km	-0.07	-0.16**	-0.13*	-0.01	-0.12	-0.07	-0.09	-0.10	-0.12*	-0.05	-0.07	-0.28	-0.11*	-0.07	-0.39*	-0.07
	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.06]	[0.06]	[0.07]	[0.07]	[0.07]	[0.05]	[0.22]	[0.06]	[0.08]	[0.21]	[0.05]
Observations	185,772	166,735	107,610	102,065	77,482	142,982	125,559	94,905	114,518	90,119	81,672	122,965	102,823	101,814	105,818	98,819
N of unique persons	18,127	17,078	12,807	9,085	7,142	11,274	10,147	8,269	8,697	6,369	5,948	9,118	7,577	7,489	7,871	7,195
Mean of dep. variable	6.83	6.68	6.55	7.02	6.43	6.94	6.70	6.85	6.62	6.97	6.92	6.68	6.81	6.74	6.87	6.67
Proportion affected (%)	0.34	0.34	0.61	0.51	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.08
Panel F:	Neighbourhood satisfaction															
Any category 5 cyclone within 100 km	-0.05	-0.10	-0.09	0.06	-0.05	-0.06	-0.07	-0.03	-0.06	-0.07	-0.04	-0.23	-0.06	-0.08	-0.33	-0.05
	[0.06]	[0.07]	[0.07]	[0.06]	[0.08]	[0.05]	[0.06]	[0.06]	[0.07]	[0.06]	[0.05]	[0.21]	[0.06]	[0.07]	[0.23]	[0.05]
Observations	185,942	166,843	107,716	102,141	77,571	143,080	125,533	95,118	114,692	90,159	81,775	123,076	102,876	101,975	105,922	98,929
N of unique persons	18,129	17,083	12,812	9,088	7,142	11,279	10,140	8,281	8,704	6,370	5,953	9,121	7,579	7,495	7,875	7,199
Mean of dep. variable	7.92	7.86	7.75	8.03	7.62	8.03	7.78	8.02	7.76	8.05	7.96	7.84	7.97	7.80	7.93	7.85
Proportion affected (%)	0.34	0.34	0.61	0.51	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.09
Panel G:	Personal safety satisfaction															
Any category 5 cyclone within 100 km	0.01	-0.09*	-0.12**	0.07	-0.04	-0.04	-0.09*	0.03	-0.02	-0.05	-0.03	0.09	-0.05	-0.01	-0.05	-0.04
	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]	[0.04]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.14]	[0.05]	[0.06]	[0.15]	[0.04]
Observations	186,102	166,937	107,771	102,237	77,671	143,150	125,649	95,172	114,799	90,215	81,829	123,185	102,955	102,059	106,005	99,009
N of unique persons	18,137	17,087	12,813	9,093	7,147	11,280	10,143	8,284	8,704	6,372	5,952	9,124	7,581	7,495	7,876	7,200
Mean of dep. variable	8.19	8.33	8.26	8.21	8.12	8.30	8.12	8.39	8.18	8.34	8.36	8.17	8.28	8.22	8.28	8.22
Proportion affected (%)	0.34	0.34	0.61	0.52	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.09
Panel H:	Health satisfaction															
Any category 5 cyclone within 100 km	-0.04	-0.17***	-0.12**	-0.03	-0.11	-0.08*	-0.07	-0.12*	-0.11*	-0.09*	-0.09**	-0.08	-0.03	-0.20***	-0.37*	-0.09**
	[0.06]	[0.05]	[0.06]	[0.06]	[0.07]	[0.05]	[0.05]	[0.06]	[0.05]	[0.06]	[0.04]	[0.19]	[0.05]	[0.07]	[0.21]	[0.04]
Observations	186,158	166,997	107,805	102,292	77,717	143,206	125,614	95,309	114,840	90,268	81,883	123,225	102,985	102,123	106,045	99,063
N of unique persons	18,139	17,085	12,817	9,093	7,151	11,280	10,140	8,291	8,706	6,374	5,956	9,124	7,581	7,499	7,878	7,202
Mean of dep. variable	7.21	7.31	7.55	6.96	7.11	7.35	7.09	7.50	7.13	7.44	7.23	7.29	7.34	7.18	7.29	7.23
Proportion affected (%)	0.34	0.34	0.61	0.52	0.67	0.46	0.55	0.51	0.59	0.51	1.30	0.06	0.67	0.44	0.06	1.09

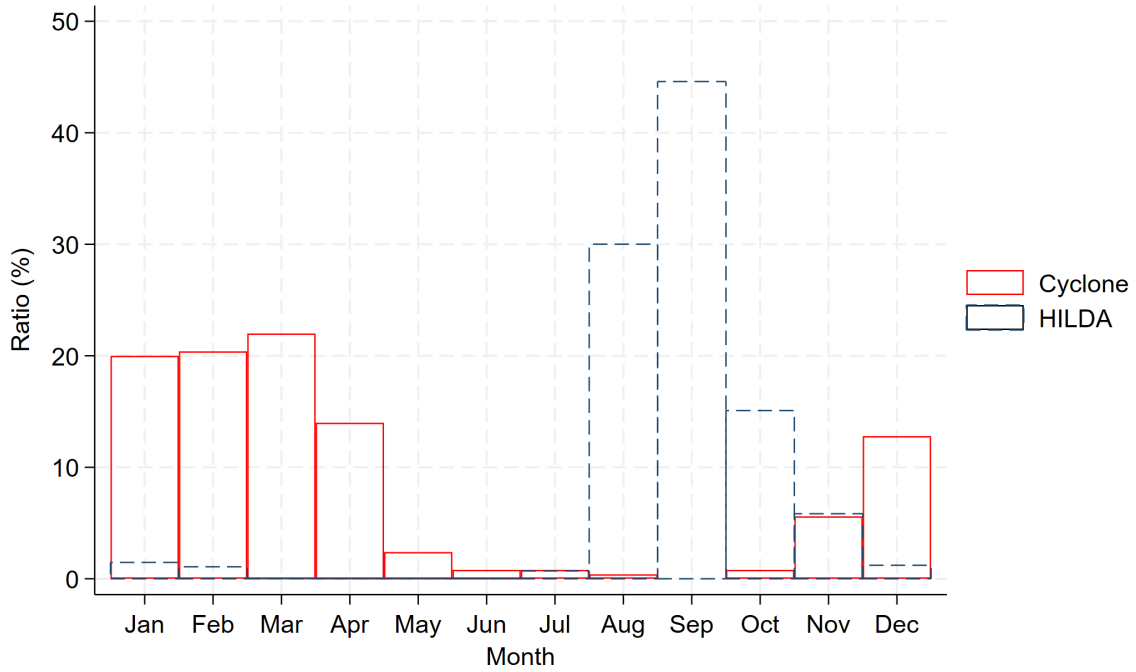
Notes: The results presented in each column and panel are based on a separate FE regression. Other explanatory variables include age (and its square), education, household size, local area socio-economic variables, state/territory dummies, year dummies, and survey month dummies. Robust standard errors clustered at the individual level in parentheses. The symbol *denotes significance at the 10% level, **at the 5% level, and ***at the 1% level.

Appendix Figure A1: Tropical cyclone hit map between 2000 and 2024



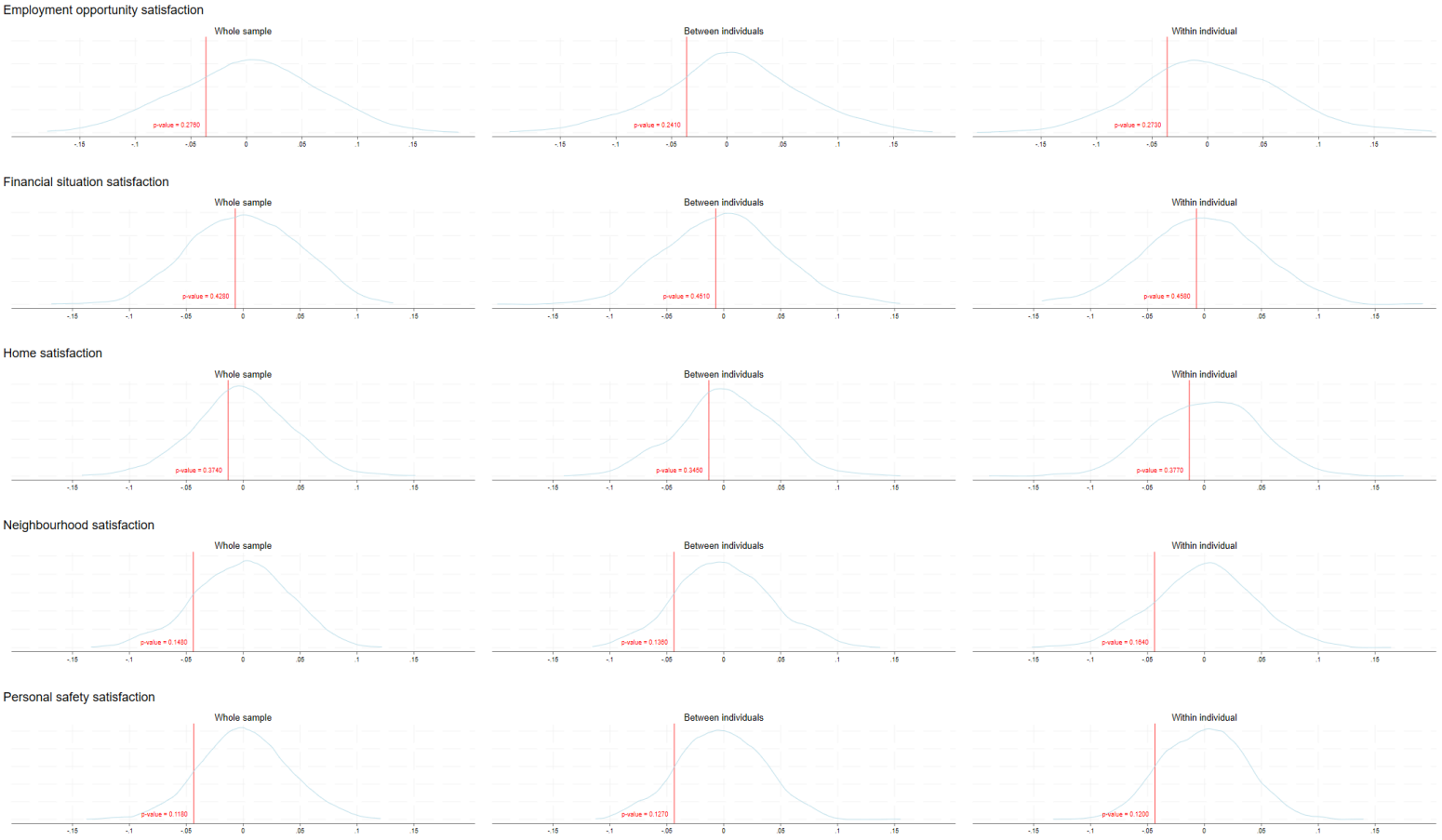
Notes: Cyclone category is classified using the maximum wind speed cut-offs from BOM. Only names and years of category 5 cyclones are listed.

Appendix Figure A2: Distribution of cyclone occurrence and HILDA interview dates



Notes: Data from historical tropical cyclone observed from 2000 to 2024 and HILDA Release 23.

Appendix Figure A3: Randomization tests – Remaining results



Notes: This figure depicts the distribution of 1000 regression estimates for the effect of randomly assigned exposure to a category 5 cyclone within 100 km of its eye, derived using Equation (1). We use the Stata command rndm, developed by Hsiang and Jina (2014), to implement the randomization procedure. The vertical red line indicates the observed effect of exposure to a category 5 cyclone within 100 km of its eye, as obtained from real data and Equation (1). The p-value is calculated as the probability that the estimate from the real data is smaller than or equal to the estimates from the randomized data.

Appendix Table B1: Summary of the literature on natural disasters and life satisfaction/subjective wellbeing/happiness

Study	**Dependent variable**	**Disaster event and main exposure measure**	**Level of disaster exposure measure**	**Location**	**Main micro dataset and panel nature**	**Main findings**
Carroll *et al.* (2009)	Life satisfaction (10-point scale)	Event: Droughts Measure: Meteorological drought	Regional (Postcode level)	Australia	Dataset: Australian Unity Wellbeing Index survey with about 2,000 individuals surveyed each wave Data type: Repeated cross-sectional	Negative only for rural residents
Luechinger and Raschky (2009)	Life satisfaction (4-point scale)	Event: Floods Measure: Events are included if they fulfill at least one of the following criteria: 10 or more people reported killed, 100 people reported affected, declaration of a state of emergency or call for international assistance	Regional (NUTS 2 level)	Europe	Dataset: Eurobarometer Survey Series Data type: Repeated cross-sectional	Negative
Kountouris and Remoundou (2011)	Life satisfaction (4-point scale)	Event: Forest fires Measure: Number of forest fire incidents and the forest area affected	Regional (NUTS 2 level)	Europe	Dataset: Eurobarometer Survey Series Data type: Repeated cross-sectional	Negative only for rural residents
Calvo *et al.* (2015)	Happiness (4-point scale)	Event: Hurricane Katrina Measure: Self-reported hurricane stressors, bereavement, and property damage	Individual	US	Dataset: 491 women affected by Hurricane Katrina Data type: Panel	Negative
Rehdanz *et al.* (2015)	Self-reported wellbeing (11-point scale)	Event: Tsunami and nuclear accident at Fukushima in 2011 Measure: Distance from the individual's residing municipality to the disaster	Regional (municipality level)	Japan	Dataset: Panel data for 5,979 individuals interviewed in Japan before and after the disaster Data type: Panel	- Negative - More pronounced for residents in greater proximity to the disaster
Berlemann (2016)	Happiness (4-point scale) and life satisfaction (10-point scale)	Event: Hurricanes Measure: Annual number of hurricanes whose centres pass a country's borders up to a 160 km distance	Country	Multiple countries	Dataset: European/World Values Survey Data type: Repeated cross-sectional	- Negative - More pronounced for lower income countries - No lasting impact
Sekulova and Van den Bergh (2016)	Life satisfaction (10-point scale)	Event: Floods Measure: Self-reported material and psychological damages	Individual	Bulgaria	Dataset: Survey about 600 respondents Data type: Cross-sectional	Negative

Study	Dependent variable	Disaster event and main exposure measure	Level of disaster exposure measure	Location	Main micro dataset and panel nature	Main findings
Van Ootegem and Verhofstadt (2016)	Life satisfaction (11-point scale)	Event: Floods Measure: Self-reported severity of the flood, the recurrence of floods and their fear of future flooding	Individual	Belgium	Dataset: Survey about 1,000 respondents Data type: Cross-sectional	Insignificant impact
von Möllendorff and Hirschfeld (2016)	Life satisfaction (11-point scale)	Event: Multiple natural disasters Measure: Events are based on their intensity which is approximated by the claims expenditure they caused for insurances	Regional (NUTS 3 regions)	Germany	Dataset: German Socio-Economic Panel Study (SOEP) Data type: Panel	- Negative - Floods have a lasting impact
Hudson *et al.* (2019)	Subjective wellbeing (11-point scale) and 7 domains	Event: Floods Measure: Self-reported flood experiences	Individual	France	Dataset: Survey of 900 flood-prone households in France Data type: Cross-sectional	Negative
Lohmann *et al.* (2019)	Life satisfaction (10-point scale)	Event: Heavy storms and droughts Measure: Self-reported past experienced events, damage suffered, perceived vulnerability and expectations for future events to occur	Individual	Papua New Guinea	Dataset: Survey 515 respondents Data type: Cross-sectional	Negative for droughts
Ahmadiani and Ferreira (2021)	Life satisfaction (4-point scale)	Type: Multiple extreme weather events. Measure: Number of deaths and estimated monetary damages	Regional (county level)	US	Dataset: Behavioral Risk Factor Surveillance System Data type: Repeated cross-sectional	Negative
Berlemann and Eurich (2021)	Expected future wellbeing (10-point scale)	Event: Droughts Measure: Drought severity and drought risk are measured at a 5 km-grid-level	Regional (Zip code)	US	Dataset: Gallup Daily Tracking Survey Data type: Repeated cross-sectional	- Negative - More pronounced for poorer individuals
Johnston *et al.* (2021)	Life satisfaction (11-point scale) and 6 satisfaction domains	Event: The 2009 Black Saturday Bushfires Measure: Distance from individual's residing region to wildfires	Regional (Statistical Areas Level 1 (SA1))	Australia	Dataset: Household, Income and Labour Dynamics in Australia (HILDA) Data type: Panel	- Negative - More pronounced for females, older, unmarried, or lower income individuals - No lasting impact
Stein and Weisser (2022)	Subjective wellbeing (5-point scale)	Event: Floods Measures: Self-reported flood experience and distance from household's residing coordinates to satellite-based floods	Individual	Thailand and Vietnam	Dataset: Thailand Vietnam Socio Economic Panel (TVSEP) Data type: Panel	- Negative - Lasting impact

Study	Dependent variable	Disaster event and main exposure measure	Level of disaster exposure measure	Location	Main micro dataset and panel nature	Main findings
Frijters *et al.* (2023)	Wellbeing (11-point scale)	Type: Multiple natural disasters Measure: County is identified as affected if it received a presidential Major Disaster Declaration	Regional (county level)	US	Dataset: Gallup Polls Data type: Repeated cross-sectional	- Negative - More pronounced for white, older, and economically advantaged subpopulations.
Gunby and Coupé (2023)	Life satisfaction (11-point scale) and home satisfaction	Event: Weather-related home damage Measure: Self-reported home damage	Individual	Australia	Dataset: Household, Income and Labour Dynamics in Australia (HILDA) Data type: Panel	Insignificant impact

Notes: The studies are listed chronologically and alphabetically.