GRANULAR

WELLBEING AND QUALITY OF LIFE IN RURAL EUROPE

D4.4

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Executive summary

A society in which more people experience a higher quality of life—essentially, a greater wellbeing—is an important policy goal. This ambition is increasingly recognised across Europe, as reflected, for example, in the European Commission's *Long-Term Vision for Rural Areas* (European Commission 2021), which places wellbeing, fairness and quality of life at the centre of rural development through to 2040. Yet the drivers of wellbeing remain complex, going well beyond traditional measures such as GDP.

This report contributes to the evidence base by exploring how subjective wellbeing (SWB) varies across rural and urban contexts in Europe. It builds on new opportunities afforded by large-scale, high-quality survey data and their geographical linkages. Using three major datasets—the European Social Survey (ESS), the UK Household Longitudinal Study (UKHLS/Understanding Society), and the German Socio-Economic Panel (SOEP)—we examine how settlement type, socio-ecological context, and environmental exposures shape different dimensions of wellbeing.

The analysis proceeds in four main steps:

- **Systematic review (Chapter 2):** Across the literature, a consistent but nuanced *rural subjective wellbeing advantage* emerges, particularly for evaluative life satisfaction measures. However, results vary strongly depending on how "rural" and "urban" are defined. Respondent-based definitions (e.g., "farm/countryside") yield clearer rural advantages than administrative or density-based definitions.
- **Wellbeing dimensions (Chapter 3):** Rural life is associated with higher social wellbeing and mental resources (e.g., resilience, optimism), while advantages in life satisfaction and affective wellbeing often diminish once individual and country characteristics are controlled for. Differences also vary by welfare state grouping: Nordic, Central European, Mediterranean and Eastern European settlement types each show distinct wellbeing profiles.
- **Neighbourhood and context effects (Chapter 4):** Rurality remains positively linked to life satisfaction, but the effect weakens once neighbourhood characteristics are included. Area deprivation has a consistently negative impact in all settings. Contextual influences, such as access to health services and environmental quality, explain some—but not all—of the observed rural advantage in life satisfaction.
- **Environmental exposures (Chapter 5):** A case study of onshore wind turbines in Germany illustrates the complexity of local environmental impacts. Fixed-effects models suggest that proximity has a negative effect on physical health-related quality of life (as measured by the SF-12). At the same time, quasi-experimental designs reveal that larger turbines can be associated with improved physical wellbeing—likely reflecting community benefits. However, turbine density undermines mental wellbeing, highlighting the importance of careful siting and engagement strategies.

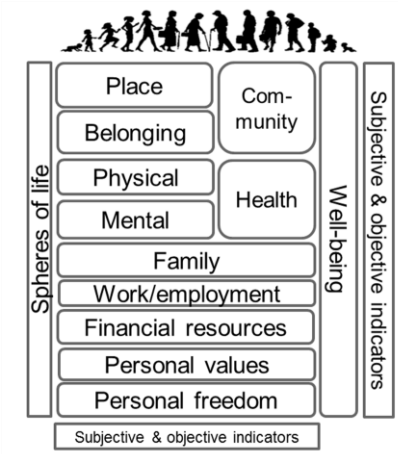
Policy implications:

- Acknowledge the heterogeneity of rural experiences by recognising that rural living influences different dimensions of wellbeing in diverse ways across contexts and populations.
- Move beyond simplistic rural–urban binaries by adopting more nuanced, fine-grained definitions of place.
- Mitigate contextual risks, including socioeconomic deprivation, limited-service provision, and cumulative environmental pressures.
- Embed wellbeing considerations into rural policy frameworks, ensuring that initiatives—such as renewable energy deployment and other forms of development—are responsive to residents' lived experiences and perceptions.

Taken together, the analysis demonstrates that subjective wellbeing offers a valuable perspective for understanding rural–urban differences. By integrating conceptual, empirical, and methodological insights, the report identifies both opportunities and challenges in advancing wellbeing in rural Europe, thereby providing evidence in support of the European Commission's aim to foster thriving, resilient, and inclusive rural areas by 2040.

1. Introduction

What matters for well-being?



A society where more people experience a better and more positive quality of life—essentially, a greater wellbeing—is a worthy goal. Policymakers around the world are increasingly focused on creating conditions that support this aspiration, which also aligns with the European Commission's Long-Term Vision for Rural Areas (European Commission 2021). The Vision explicitly adopts wellbeing, fairness and quality of life as central goals for rural Europe through to 2040. The traditional emphasis on economic growth as the primary means to enhance wellbeing is being questioned. There is a growing need to understand what contributes to wellbeing beyond just measuring GDP.

Data on wellbeing is crucial in this context. Only by systematically gathering detailed information about people's experiences in various aspects of wellbeing, alongside broader insights into different areas of their lives, can we develop a comprehensive understanding of what drives wellbeing. This understanding is essential for creating effective policies aimed at maximising overall wellbeing. The EU Vision similarly emphasises strengthening data collection and monitoring for rural areas (including a rural observatory and rural proofing of policies) to better capture quality of life beyond economic indicators.

Over the past two decades, researchers across economics, psychology, sociology, and geography have honed in on subjective wellbeing (SWB) — broadly comprising both evaluative dimensions (e.g., life satisfaction) and affective dimensions (e.g., momentary happiness, psychological functioning) — to understand how individuals perceive their quality of life and how social, economic, and environmental contexts shape these perceptions. A fascinating finding in the literature examining the relationship between place and subjective wellbeing (SWB) is the somewhat counterintuitive finding that rural residents frequently report levels of SWB that match or exceed those of urban populations, even though rural areas tend to score lower on many objective indicators of wellbeing, such as income, service provision, and employment opportunities. This "urban happiness paradox" challenges conventional wisdom about the benefits of urban agglomeration and highlights the need to understand the complex interplay between place, personal circumstances, and wellbeing.

This report seeks to advance our understanding of rural–urban differences in SWB by addressing two interrelated sets of puzzles. First, why do some studies document a clear "rural wellbeing advantage" while others find no such effect? We argue that heterogeneity in measurement — both of SWB itself and of what constitutes "rurality" — underlies many of these divergent findings. Second, beyond simple comparative statements, what specific socio-ecological characteristics of rural contexts contribute to the wellbeing of their inhabitants? To answer these questions, we employ a multi-chapter approach that combines systematic literature review, theoretical extension to multiple dimensions of SWB, and novel empirical analyses leveraging fine-grained geographic linkages.

Europe has seen a significant investment in new data on subjective wellbeing since the early 2000s – for example, the European Quality of Life Survey (EQLS) and the focused module on "Personal and Social Wellbeing" in the third and sixth rounds of the European Social Survey (ESS). In parallel, many data custodians also expanded the range of geodemographics and other socio-ecological context data, as well as facilitating an increased array of geographical data linkages. For example, the German Socio-economic Panel (SOEP) began making the postcode of the survey participants' addresses available for analysis in a secure setting in 2004 (although only going back to 2000, rather than to the start of the longitudinal household panel study, which started in 1986). Since 2010, it has been possible to draw on the exact geolocation of SOEP respondents' addresses, again in a secure setting (Goebel, Wurm and Wagner 2010). The British sister study of SOEP, the British Household Panel Study (BHPS), also began to make fine-grained data from the UK Census 1991 available for analysis in secure settings around the turn of the Millennium. In 2012, the ESS released, for the first time, a linked geodata file with its cross-national survey data. By

coincidence, this occurred in the year it also conducted the designated personal and social wellbeing module for the second time. However, due to data access restrictions, the spatial scale of the geocoded information released varied widely, with countries such as Germany only permitting context information at the state level (i.e., Bundesländer), while countries like Finland provided information at the NUTS 3 level (i.e., county-level). Both the German SOEP and the British BHPS/Understanding Society studies conclude in their anniversary reviews that the opportunities afforded by geographical data linkages have, as yet, not been fully utilised (Giesselmann, Bohmann et al. 2019, Platt, Knies et al. 2020).

In our empirical analyses, we draw on three powerful European studies— each with unique strengths in wellbeing measurement and spatial detail—to provide complementary evidence for understanding how rural contexts foster or constrain the subjective quality of life.

The European Social Survey (ESS) offers a comprehensive range of measures for personal and social wellbeing, particularly in Rounds 3 (2006), 6 (2012), and the upcoming Round 12 (2026). It allows us to compare the experience of life using the same, cross-nationally harmonised and rigorously tested instruments across different places in Europe. However, when defining our population of interest, we are limited to using the respondents' accounts of whether they live in a country village, a farm, or a house in the countryside; we do not have exact information about where in the country the respondents live.

European Social Survey (ESS)

The European Social Survey is a biennial survey of social attitudes and behaviour which has been carried out in up to 36 European countries since 2001. The number of respondents varies across countries and rounds of interview.

The UK Household Longitudinal Study (UKHLS) is recognised as the largest study of its kind in the world. Among its benefits is that we have a large, geographically dispersed, and regionally representative sample, enabling us to compare the experiences of life in different rural contexts and across various stages of the life course. We can, for example, track the life satisfaction of children from age 10 and observe whether the neighbourhood context changes (which may be due to a change in housing). To define our population of interest, we can use several different classifications, such as the National Statistical Office's Rural-Urban Classification (RUC) and the new Degree of Urbanisation (DEGURBA2) created by Eurostat. Both classifications are based on population density and size. The key advantage of the UKHLS is that we can (under special license user agreements, issuable in research institutions in the UK and Europe) access the respondents' neighbourhood identifier and augment the data with a rich pool of geocoded information publicly available in online archives such as the Open Geoportal (Office for National Statistics n.d.). Context information available through this route ranges from geodemographic classifications to details about access to fast food outlets, pubs, off-licences, tobacconists, gambling outlets, GPs, hospitals, pharmacies, dentists, leisure services, Blue Space, Green Space and air quality (see, e.g., Consumer Data Research Centre n.d.).

Understanding Society (UKHLS)

The UK Household Longitudinal Study is a multi-topic social survey which has been carried out since 2009. The same individuals and members of their households are interviewed annually. Each year, around 30k people aged 10 and older participate in the study.

The German Socio-economic Panel (SOEP) is similar in design to the UKHLS. However, given the strict interpretation of data protection law in Germany, the study could not expect to augment the survey data with as rich a pool of local context data as is available in the UK. While the survey has asked respondents to report the distance on foot to various locations, including grocery stores, pubs/restaurants, banks, general practitioners, primary schools, secondary schools, youth clubs, institutions for older people, green areas, and sports grounds, in 5-yearly intervals (most recently: 2019), the availability of the exact latitude and longitude of the respondents' homes since 2000 offers nearly full flexibility over which geospatial context data can be linked to the survey data, albeit in a restrictive safe setting and limiting the amount of results that can be exported.

Socio-economic Panel (SOEP)

The German Socio-economic Panel is a multi-topic socio-economic survey which has been carried out since 1986. The same individuals and members of their households are interviewed annually. Each year, over 20k people aged 14 and older participate in the study.

We use the three survey data sources to:

- **Clarify measurement issues**: Chapter 2 reviews existing empirical work on rural–urban differences in SWB, paying particular attention to how SWB is operationalised (e.g., life satisfaction vs. affective measures) and how "rural" and "urban" areas are defined (e.g., administrative classifications, population density thresholds, self-reported settlement type). We demonstrate that measurement choices can systematically bias estimates of rural–urban gaps and obscure important nuances.
- **Extend conceptual dimensions in rural wellbeing research**: Chapter 3 builds on the growing recognition that wellbeing is more than life satisfaction and momentary mood. Drawing on hedonic and eudaimonic traditions, as well as recent integrative frameworks (e.g., self-determination theory), we explore how psychological functioning (e.g., autonomy, competence, relatedness), mental resources (e.g., optimism, resilience), and social wellbeing (e.g., trust, social cohesion, loneliness) may differ across rural and urban environments.
- **Extend knowledge about how different rural classifications and spatial features covary with rural wellbeing**: Chapter 4 provides a closer examination of the complexities surrounding definitions of rurality and their significant impact on findings related to life satisfaction. By employing data from the UK Household Longitudinal Study (UKHLS), this chapter challenges existing assumptions about rural wellbeing. It highlights the variability in life satisfaction based on alternative definitions of rural environments.
- **Explore causal associations via place-of-interest data in rural areas**: Chapter 5 presents a case study on the effects of onshore wind turbine installations in Germany on a specific dimension of wellbeing: health-related quality of life. Exploiting precise geocoded facility locations, installation dates, and high-frequency longitudinal survey data (SOEP), we implement a within-individual design to isolate causal impacts of environmental exposures. This methodology illustrates the power of point-level data linkages for identifying local context effects, be it in rural or urban areas.

Together, these chapters offer a nuanced understanding of wellbeing in rural Europe, providing key insights that can inform policymakers and stakeholders seeking to enhance the quality of life in rural settings. Moreover, as the analysis indicates, while significant strides have been made in collecting wellbeing data, a gap remains in understanding rural-specific factors that contribute to overall subjective wellbeing. By addressing this gap, this report aims to contribute to a more comprehensive understanding of wellbeing that extends beyond mere economic indicators and encompasses the richness of human experience in diverse settings. By contributing to understandings of rural-specific factors, this report can help align empirical evidence with the implementation of the EU Vision and its Action Plan, supporting policy measures targeting wellbeing in rural areas by 2040.

2. Subjective Wellbeing in Rural and Urban Contexts: Is there a rural wellbeing advantage in Europe?

2.1. Introduction

Subjective wellbeing (SWB), often defined as how individuals experience the quality of their lives and their emotional reactions, has become a central focus in social science research. Analysts of subjective wellbeing (in particular: “life satisfaction” and “happiness”) have made a convincing case that subjective wellbeing measures not only capture very immediate aspects of positive and negative life experiences but are also linked to subsequent outcomes, including differences in morbidity and mortality risks (e.g., Diener and Chan 2011). Subjective wellbeing is, therefore, an important outcome and potential source of inequalities in its own right. It is informative about how well people are faring, and we know an increasing amount about its determinants and correlates (Layard 2005, Kahnemann and Krueger 2006, Diener, Oishi and Tay 2018, Kaiser and Oswald 2022) such as strong social relations (Lucas and Dyrenforth 2006), income and employment (e.g., Biswas-Diener 2008, Erdogan, Bauer et al. 2012), and good health (Steptoe, Deaton and Stone 2015, Diener, Pressman et al. 2017).

While much of the empirical literature on SWB has concentrated on the population as a whole and the characteristics of individuals and their families in producing greater individual wellbeing, there is an emerging body of literature that examines which social-ecological factors affect wellbeing, such as neighbourhood deprivation (e.g., Knies, Melo and Zhang 2020), physical aspects of the environments (e.g., MacKerron and Mourato 2013), urban green spaces (e.g., White, Alcock et al. 2013) and air quality (e.g., Luechinger 2009). Empirical studies have found support for the positive impacts of access to green space on stress exposure and coping (van den Berg, Maas et al. 2010), as well as physical health and psychological wellbeing (Wolch, Byrne and Newell 2014). Similarly, Sorensen (2014) has found that access to natural amenities predicts rural wellbeing advantages and explains much of the variation in wellbeing within urban areas (also see Ambrey 2016). Recent studies have also begun to explore how subjective wellbeing differs across rural and urban settings **(**Lolle 2023**)**. With their distinct social, economic, and environmental characteristics, rural areas may present unique challenges and advantages that shape individuals' perceptions of their life experiences. Overall, it seems that urban populations have lower happiness than rural populations, a counterintuitive finding in wellbeing research referred to as the “urban happiness paradox”: while people in urban areas tend to have access to more economic resources, services, and opportunities, they often report lower levels of subjective wellbeing compared to people in rural areas.

Meanwhile, public discourse about rural areas often describes rural areas as “left behind” and as a breeding ground for protest voting; rural people are at times characterised as frustrated and dissatisfied with governments and social progress in general (De Ruyter, Martin and Tyler 2021), and there is no clear explanation why rural areas might have higher degrees of subjective wellbeing (Burger, Morrison et al. 2020, Weckroth and Kemppainen 2021). Overall, the urban happiness paradox highlights the complexity of wellbeing and how factors beyond material wealth—such as social connections and environmental conditions—can influence how happy people feel in various living contexts. Unfortunately, little is known about which socio-ecological characteristics affect the wellbeing of people living in rural areas (cf. Samavati and Veenhoven 2024 for findings on which factors affect the wellbeing of urban residents).

This literature review complements two recent reviews of rural subjective wellbeing (Wang and Wang 2015, Lolle 2023) by investigating how measurement approaches may explain why some studies report a rural wellbeing advantage, while others do not. We ask: Are there significant differences in subjective wellbeing (SWB) between rural and urban areas in Europe, including evidence for a rural wellbeing advantage, and what factors explain this advantage? We focus on two key aspects: the measurement of subjective wellbeing (SWB) and the operationalisation of rurality. We were also interested in identifying the geospatial factors that contribute to SWB in rural settings; unfortunately, however, our literature search yielded too few studies that used geographical context variables to provide meaningful insights (N=8 studies with 27 effects).

Regarding SWB, much of the literature emphasises life satisfaction — i.e., cognitive evaluations of overall quality of life (e.g., “On a scale from 0 to 10, how satisfied are you with your life?”) — over immediate emotional states, such

as happiness. Happiness is a distinct construct, capturing momentary feelings of joy and pleasure (e.g., "How happy do you feel right now?"). Notably, some surveys include overall happiness ratings (e.g., "In general, how happy are you?"), which aligns more with evaluative wellbeing than with affective wellbeing[1]. The European Social Survey (ESS), for example, routinely includes both a general life satisfaction and a general happiness question: the correlation between the two measures is very high (around 0.8). In some rounds of the survey, an affective wellbeing happiness measure is also included: "How happy were you yesterday?" The correlation between general happiness and momentary happiness is relatively low (around 0.3). Given the prominence of life satisfaction measures in large-scale social surveys, the urban happiness paradox is, in all likelihood, an urban life satisfaction paradox, and we do not know if there is empirical evidence of an affective wellbeing advantage in rural areas.

Equally critical is how rurality is defined. Rural-urban classifications vary, ranging from official area definitions based on population density or administrative boundaries to self-reported settlement types. In all likelihood, based on our previous research into neighbourhood effects on subjective wellbeing (e.g., Knies and Melo 2019), the bulk of the research will have used official area classifications that are made available with the large-scale representative surveys (or can be added, with more or less hassle, to such surveys through data linkage). However, many surveys asked the respondents to report which settlement type best describes the area where they live. These differences in operationalisation can lead to divergent findings, as each method captures distinct aspects of the rural experience, such as economic structure, access to services, and social context. Indeed, if the degree of urbanisation is assessed at a very large geographical scale, such as counties (i.e., NUTS3 areas), the definition may not capture anything meaningful that we expect to transpire as a rural wellbeing advantage. The county may include, for example, charming liveable villages, remote left-behind places, and towns of varying qualities and sizes.

Understanding measurement nuances is essential for accurately interpreting research on rural wellbeing. By clarifying how both SWB and rurality are operationalised, this review aims to resolve apparent contradictions in the literature and provide local actors with reliable insights.

2.1. Searching and reviewing the empirical literature – how it was done

We selected online databases commonly used in the social sciences, specifically Scopus, Web of Science, ProQuest, and PsycINFO, to identify studies that may be included in a systematic review of the effects of rural areas on subjective wellbeing. The search string used consists, firstly, of the definition of the outcome(s) of interest and comprises specific terms such as "happiness", "life satisfaction", "subjective Quality of Life", or "subjective Wellbeing/Wellbeing". The second part of the search string defines the major intervention or criteria of interest, which is the analysis of rural wellbeing and rural-urban differences. Boolean operators and wildcards were used, when possible (e.g., in SCOPUS region* also captures regional), depending on the demands of each database. To uncover relevant grey literature, the *Thesis* search option in ProQuest was used. Additionally, each article cited in the reviews by Wang and Wang (2015) and Lolle (2023) was considered, and the World Database of Happiness (Veenhoven 2014) was queried for studies that assess local, regional, or national geographic variations in subjective wellbeing.

To evaluate the effectiveness of different search strings, several candidate strings (see Table 2-1) were tested against a master list of relevant publications (see Table 2-2). The most comprehensive search string applied in SCOPUS identified 90% of the master list. It failed to capture one report that was not indexed and a paper that only used the general term "wellbeing" (see Table 2-1). Including broad terms such as "wellbeing" and "quality of life" without the qualifier "subjective" resulted in an unmanageably large number of irrelevant hits—over 30k abstracts—making the screening process infeasible. Conversely, a minimal search string that included only "rural", "urban," and the outcomes "subjective well*", "happiness", "life satisfaction", or "subjective quality of life" captured only 50% of the master list. The final, compromise search string (labelled "final" in Table 2-1) successfully identified 90% of the master list while substantially reducing the number of studies requiring screening.

1 Evaluative well-being refers to people's overall, reflective judgments about their lives (e.g., life satisfaction ratings). Affective well-being refers to the moment-to-moment experience of positive and negative emotions (e.g., frequency of joy vs. sadness).

Table 2-1: Search Term Selection (Scopus format)

	Maximal	Minimal	Final
Outcome	TITLE-ABS-KEY ("subjective well*") OR TITLE-ABS-KEY ("life satisfaction") OR TITLE-ABS-KEY ("happiness") OR TITLE-ABS-KEY (subjective AND quality AND of AND life)	Same as maximal	Same as maximal
Intervention	TITLE-ABS-KEY (rural/urban) OR TITLE-ABS-KEY ("rural") OR TITLE-ABS-KEY ("metro") OR TITLE-ABS-KEY ("metropo*") OR TITLE-ABS-KEY ("region*") OR TITLE-ABS-KEY ("geography*") OR TITLE-ABS-KEY (across W/5 areas) OR TITLE-ABS-KEY ("urban*") OR TITLE-ABS-KEY (neighborhood) OR TITLE-ABS-KEY (neighbourhood) OR TITLE-ABS-KEY (cities) OR TITLE-ABS-KEY (city) OR TITLE-ABS-KEY (across W/5 geograph*) OR TITLE-ABS-KEY ("village")	TITLE-ABS-KEY (rural/urban) OR TITLE-ABS-KEY ("rural") OR TITLE-ABS-KEY ("urban*")	TITLE-ABS-KEY (rural/urban) OR TITLE-ABS-KEY ("rural") OR TITLE-ABS-KEY ("village") OR TITLE-ABS-KEY ("region*") OR TITLE-ABS-KEY ("geograph*") OR TITLE-ABS-KEY (across W/5 areas) OR TITLE-ABS-KEY ("urban*") OR TITLE-ABS-KEY (neighborhood) OR TITLE-ABS-KEY (neighbourhood)
Quantitative	AND NOT ("qualitative analysis") AND NOT ("qualitative study") AND NOT ("qualitative interviews")	Same as maximal	Same as maximal
English or German Language	AND (LIMIT-TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "German")	Same as maximal	Same as maximal
Articles, book chapters, reports, or books only	AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "bk") OR LIMIT-TO (DOCTYPE, "dp")	Same as maximal	Same as maximal
Other	AND NOT ("eye tracking") AND NOT ("dosage")	Same as maximal	Same as maximal

Table 2-2: Literature search string development

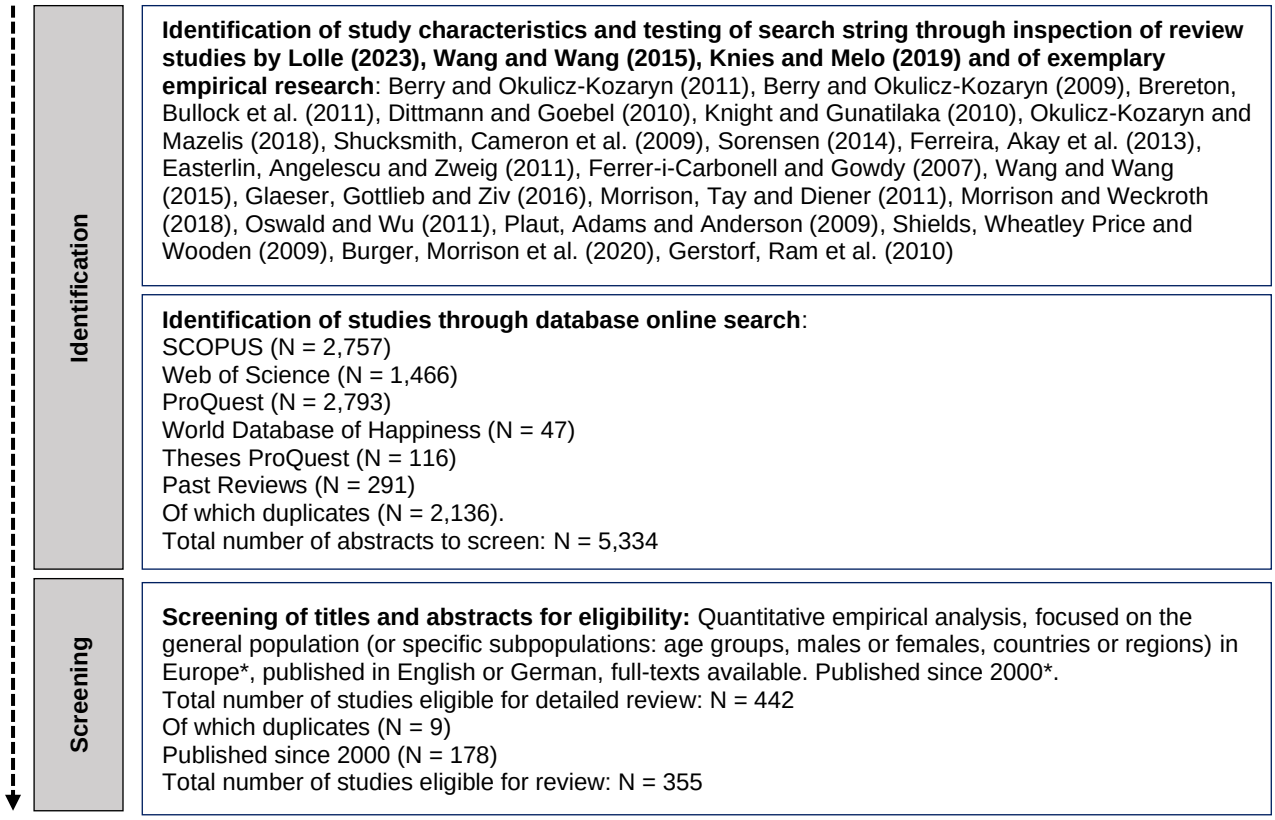
Search string identification	Articles on the master list
Identified by the minimal, maximal and final search strings	Berry and Okulicz-Kozaryn (2011), Berry and Okulicz-Kozaryn (2009), Brereton, Bullock et al. (2011), Dittmann and Goebel (2010), Knight and Gunatilaka (2010)[1], Okulicz-Kozaryn and Mazelis (2018), Shucksmith, Cameron et al. (2009), Sorensen (2014), Easterlin, Angelescu and Zweig (2011), Morrison (2021)
Not identified by the minimal search string	Ferrer-i-Carbonell and Gowdy (2007), Glaeser, Gottlieb and Ziv (2016), Morrison, Tay and Diener (2011), Morrison and Weckroth (2018), Oswald and Wu (2011)[1], Plaut, Adams and Anderson (2009), Shields, Wheatley Price and Wooden (2009)[1], Ferreira, Akay et al. (2013)
Identified by none of the search strings	Burger, Morrison et al. (2020)[2], Gerstorf, Ram et al. (2010)[3]

Notes: [1] Not included in the review because no results were presented for Europe.
[2] Report is not indexed.
[3] Drops out when "wellbeing" is dropped as a search term; inclusion results in excessive false inclusions.

Figure 2-1 summarises the literature search protocol and screening outcomes. The overall 7,460 search results from the various database searches were loaded into CADIMA, an open-access online tool developed by the Julius Kühn-Institute and the Collaboration for Environmental Evidence to streamline the work processes of systematic reviews

(Kohl, McIntosh et al. 2018). CADIMA was used to automatically remove duplicates and track decisions in the subsequent abstract screening process. To be included in the systematic review, each article had to meet all of the inclusion criteria. Four hundred forty-three studies passed the initial screening process.

Figure 2-1: Literature search criteria and outcomes



Source: Own representation of CADIMA output.

During the data analysis step, we discovered that the automatic duplicate removal tool in CADIMA missed nine duplicates. We then decided to focus on studies published since 2000, narrowing our total to 355. To enhance our review for the GRANULAR project, we added a criterion that required each study to examine subjective wellbeing in at least one European country, resulting in the exclusion of 120 studies primarily from America, Australasia, and Asia, along with 13 global studies lacking specific results for Europe. Among the remaining 222 studies, there were some reviews and doctoral theses, studies that did not focus on a general population but people suffering from specific health conditions or working in specific occupations (including farmers, teachers and clerics), had only the title and abstract in English or did not look at a global subjective wellbeing outcome of interest. Due to time constraints, we did not complete the full eligibility grid for studies that, based on the title, abstract or keyword screen, failed to meet one of the criteria. Overall, 97 studies fulfilled the final eligibility criteria (i.e., they were published after 1999, focused on a global individual subjective wellbeing measure in a general population in rural (and urban) Europe).

The data coding strategy builds on Knies and Melo (2019). It focuses on the overarching categories of “study details”, “outcome”, “rural definition” and “rural effect” to address our research questions and provide a comprehensive overview of the studies, as shown in Table 2-3. Data extraction was conducted independently by two reviewers, who then double-checked and harmonised their findings. In cases where the definition of "rural" or the subjective wellbeing outcome was missing or unclear in the paper, we consulted the survey documentation or contacted the authors for further clarification. Not all ambiguities could be resolved in this manner.

Table 2-3: Study dimensions extracted from selected research papers

Study dimension	Detail recorded
Study information	Author(s), year, title, abstract, journal, data sources
Wellbeing outcome	Detailed description, and categorised into four broad categories: Life Satisfaction (LS), Happiness (HP), Subjective Quality of Life (sQoL), and Other Subjective Wellbeing (Other SWB). Evaluative or affective wellbeing dimension, and the name of the survey instrument.
Rural indicator	Detailed information about the information used to capture the rural effect, including the type of spatial data used (if any).
Rural effect	Details about the size and direction of the rural effect, comparing more rural with less rural area type (i.e., negative numbers / Odd ratios below 1 indicating urban disadvantage and vice versa), and information about the population or subpopulation for which the effect was measured.

2.2. Results

2.2.1. Overview of the empirical evidence database

To set the scene, we begin with a brief description of the literature review database. Each row of the database represents a unique rural–urban comparison in a specific SWB outcome (hereafter "effects"). Studies appear multiple times if they report results for different regions, age groups, periods, SWB measures, or model specifications.

Table 2-4: Number of eligible studies, rural area type and rural context effects

	# of studies	# of effects
Eligible studies	97	652
No relevant effects	12	0
Final number of studies included	85	630
Studies with rural context effect(s)	8	27
Studies with area type effect(s)	80	603

Source: Own analysis of literature database.

In total, the database contains 97 eligible studies with 652 observations (Table 2-4). Twelve studies did not report empirical results on rural–urban SWB differences ("rural area type effects") or on contextual interactions ("rural context effects"). We were also interested in identifying the geospatial factors that contribute to SWB in rural settings. The literature search yielded only eight studies (27 effects) that examined how specific aspects of the rural context affect subjective wellbeing in rural populations. The following analysis, therefore, focuses on 80 studies that provide 603 "rural area type effects".[2]

As shown in Table 2-5, the database contains both studies explicitly focused on rural–urban wellbeing (N = 24, 217 effects) and studies in which area type is only one among many controls (N = 54, 382 effects). The range of topics of the "control-only" studies is broad, e.g., food consumption and lifestyle (Gschwandtner, Jewell and Kambhampati 2022), neighbourhood deprivation (Knies, Melo and Zhang 2020), the impact of tourism (Ivlevs 2017) and young people's sexual attraction and drug abuse (Kuyper, de Roos et al. 2016). Only two studies are explicitly centred on

6 We direct the Reader to a recent systematic review of rural well-being studies by Veréb, Marques et al. (2024). Although it does not focus specifically on Europe or current issues, it offers valuable insights into the factors considered to affect rural well-being. However, these factors are not categorised by individual and local levels, and the literature database remains unpublished.

rural wellbeing[3] (McGrath, Brennan et al. 2009, Jones, Malesios et al. 2020). Overall, the proportion of statistically significant effects among all effects is approximately 40% for the "control-only" and "rural-urban focus" studies.

Table 2-5: Focus of the research providing rural area type effects

	All effects		Statistically significant effects	
	# of studies	# of effects	# of studies	# of effects
Rural focus	2	4	1	2
Rural-urban focus	24	217	18	87
Control only	54	382	38	162
Total	80	603	57	251

Source: Own analysis of literature database.

Overall, the database covers research published since 2000, with the majority of effects concentrated between 2000 and 2019 (Table 2-6). The period 2000-2009 had a particularly high share of statistically significant effects (159 effects of which 83, or 52.2%, were statistically significant) compared to the pre-2000 period (68 effects of which 30, or 44.1%, were statistically significant), the 2010 to 2019 period (265 effects out of which 102, or 38.5%, were statistically significant) or the period since 2020 (29 effects out of which 11, or 37.9%, were statistically significant).

Table 2-6: Time period of effects

	All effects		Statistically significant effects	
	# of studies	# of effects	# of studies	# of effects
before 2000	9	68	5	30
2000-2009	30	159	22	83
2010-2019	33	265	22	102
since 2020	6	29	4	11
Other[1]	9	82	7	25
Total[2]	87	603	60	251

Notes: [1] Effects do not align with the discrete periods mentioned above, e.g., because they are based on surveys whose fieldwork spans two calendar years (e.g., the 2009–2010 and 2019–2020 waves of the Understanding Society study).
[2] Studies that report effects for multiple periods appear multiple times in this count.
Source: Own analysis of literature database.

Most effects are based on adult populations (aged 15+), with fewer focusing on young people or older cohorts (Table 2-7). For example, 12 studies provided a total of 32 effects relating to the population aged over 49 (e.g., Efklides, Kalaitzidou and Chankin 2003, Mollenkopf, Kaspar et al. 2004, Lang, Bachinger and Welechovszky 2013, Schmitz and Brandt 2022). Seven studies (32 effects) relate to the population aged under 20 (e.g., Eriksson, Hochwälder

3 Other studies have a rural focus but provide only rural context effects (Oswald, Wahl et al. 2003, Mollenkopf and Kaspar 2005, Brereton, Bullock et al. 2011, Podgorelec, Gregurović and Bogadi 2015). No rural area type or rural context effects are reported in the otherwise relevant studies by Triadó, Villar et al. (2009), Beck and Elkeles (2012), Michalska-Żyła and Marks-Krzyszkowska (2018), Vaznonienė and Wojewódzka-Wiewiórska (2021), Dercan, Zivkovic et al. (2022).

and Sellström 2011, Labiscsak-Erdelyi, Veres-Balajti et al. 2022, Róbert, Geszler and Nagy 2022).[4] Only four studies reported differences in rural-urban wellbeing for males and females (i.e., Ek, Koiranen et al. 2008, Carta, Aguglia et al. 2012, González-Carrasco, Casas et al. 2019, Keller, Groot et al. 2022).

Table 2-7: Characteristics of the population for which rural area type effects have been reported

	All effects		Statistically significant effects	
	# of studies	# of effects	# of studies	# of effects
Age of the study population				
Aged 15 or older (no upper bound)	57	502	45	220
Aged 50 or older	12	32	7	12
Aged under 20	7	36	2	8
Aged 18-65 (working age)	4	20	3	7
Aged 15-25 (young people)	4	13	3	4
Total	84	603	60	251
Sex of the study population				
Both sexes pooled	78	561	54	235
Females	4	21	3	8
Males	4	21	4	8
Total	86	603	61	251

Source: Own analysis of literature database

Grouping countries according to the welfare state typology developed by Lauzadyte-Tutliene, Balezentis and Goculenko (2018)[5] shows that coverage is uneven: some countries are well-represented, while others are underrepresented (Table 2-8). Specifically, our review database does not include rural area type effects for any countries that fall into the welfare state groups “small European” (i.e., Luxembourg and Malta) or “Eastern European” (i.e., Bulgaria, Estonia, Latvia, Lithuania, Romania). We note, however, that Eastern European countries (and, to a lesser extent, Luxembourg and Malta) are well represented among the studies that pool cases from multiple countries. By contrast, we find that the database includes a large number of effects for the Mediterranean countries. This is partly explained by the high prevalence of regionally stratified studies published for Spain and Italy. For example, Navarro, D'Agostino and Neri (2020) provide wellbeing figures for all regions of Italy and Spain.

For further details on the literature database, including statistics for individual countries for which “rural area type” effects on subjective wellbeing have been reported, see Appendix 2 (A2-2).

4 Many child well-being studies classify schools by rurality, but we only included effects tied to children’s home addresses, as the home–school distinction matters (González-Carrasco, Casas et al. 2019). Our database thus covers 22 effects by age/sex and home urbanisation, excluding school-location results.

5 We modified groupings by separating Nordic from non-Nordic welfare states, adding a Balkan category (Albania, Kosovo, Macedonia, Serbia), and reallocating Iceland, Ireland, East Germany, and Slovakia based on historical and institutional contexts. Esping-Andersen (2001)’s welfare typology is an alternative but excludes Central and Eastern Europe.

Table 2-8: Geographic dispersion of rural area type effects.

Welfare state group of countries	All effects		Statistically significant effects	
	# of studies	# of effects	# of studies	# of effects
Eastern European	0	0	0	0
Small European	0	0	0	0
Central European	14	67	7	27
Balkan states	2	3	1	1
Mediterranean	12	129	10	39
Old European- not Nordic	30	141	18	54
Old European- Nordic	7	34	3	7
Multiple countries pooled	26	229	23	123
Total	91	603	62	251

Source: Own analysis of literature database.

2.2.2. Is there a rural advantage in subjective wellbeing?

Table 2-9 reports the proportion of rural advantage for all effects recorded in the database[6]; the right panel focuses on only the rural-urban differences (effects) that, according to the authors of the publication, were statistically significant. In our analysis, we correct all confidence intervals for clustering at the study level. Specifically, CIs and p-values are based on a wild cluster bootstrap-t procedure rather than the usual asymptotic F–test (Cameron, Gelbach and Miller 2008). By using 5000 bootstrap replications with Webb weights, we relax the large-sample and equal-cluster-size assumptions that underlie the standard F-distribution approximation. In particular, our bootstrap approach remains valid when the number of clusters is small, cluster sizes vary markedly, and the error distribution may deviate from normality, all of which can render cluster-robust standard errors and F-tests unreliable.

Table 2-9: Rural advantage in subjective wellbeing

	All effects				Statistically significant effects only			
	Mean[1]	95% CI		# of effects	Mean[1]	95% CI		# of effects
All	0.635	0.547	0.727	603	0.685	0.562	0.813	251

Notes: [1] The mean of a dummy variable with values 0 and 1 multiplied by 100 is the percentage value. We show the means in the graphs, seeing as values between 0 and 1 scale better in visualisations.
Source: Own analysis of literature review database.

It can be seen that six in ten effects indicate that the wellbeing of the population living in rural areas is higher than that of the population living in urban (or less rural) areas (mean: 63.5%, 95% CI [54.7, 72.7]). Among the 251 statistically significant effects, this figure amounts to seven in ten effects (mean: 68.5%, 95% CI [56.2, 81.3]).

6 Note that some studies reported effects using an urban base category; in such cases, we reversed the base (and the effect direction in the rural wellbeing advantage analysis). For example, if "cities" were the reference and comparisons included "farms", "villages", "small towns", etc., we only extracted coefficients for "farms" and "villages" vs. cities, reversing the sign, and ignoring the "small towns" vs. cities comparison. If "farm" was the base, we extracted all comparisons without changes. If "village" was the base, we reversed the farm-to-village coefficient and kept all others as reported.

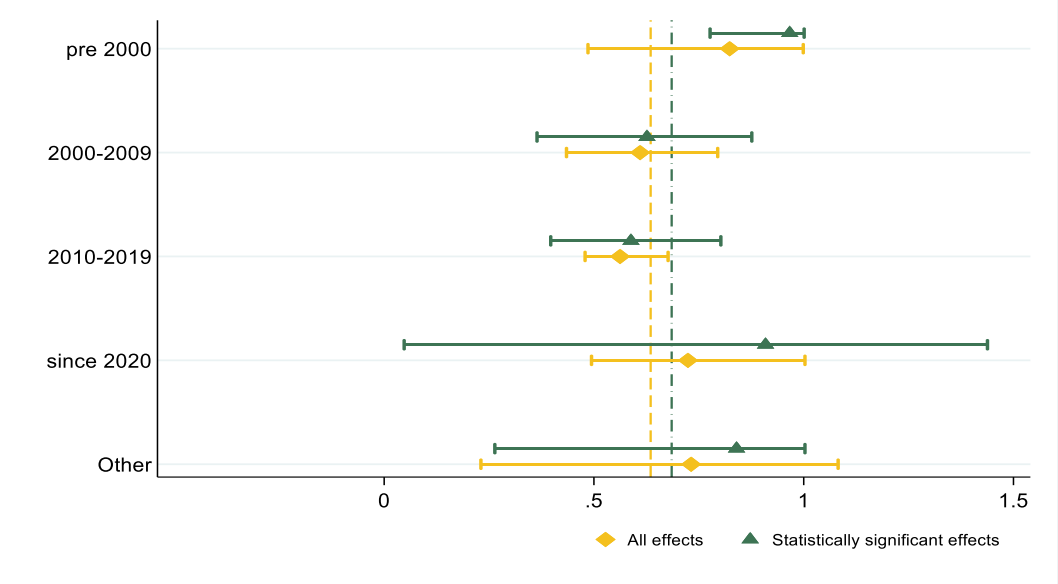
2.2.3. What factors shape the rural advantage in subjective wellbeing?

2.2.3.1. Time, geography and study population

Next, we report the proportion of effects that indicate rural advantage by several characteristics, which may underpin the rural advantage in subjective wellbeing. For results in tabular format, see the right-hand side panels of Appendix 2 (A2-2). A subgroup is considered significantly different from the overall mean if its 95% CI lies entirely above or entirely below the relevant overall mean (see Schenker and Gentleman 2001). For ease of interpretation, we visualise the results in plots, adding the 95% confidence interval around the mean values and differentiating between all effects (yellow) and statistically significant effects (green). The added vertical lines represent the overall mean (yellow dashed line) and the overall mean among statistically significant rural advantage effects (green dashed-dotted line).

Temporal variation, as shown in Figure 2-2, suggests that the rural advantage was more frequently reported before 2000 and after 2020. However, the confidence intervals are wide and only the statistically significant rural advantages reported pre-2000 reach statistical significance (M_{sig} = 0.976, 95% CI [0.777, 1.001]).

Figure 2-2: Proportion rural advantage in subjective wellbeing, by time period studied



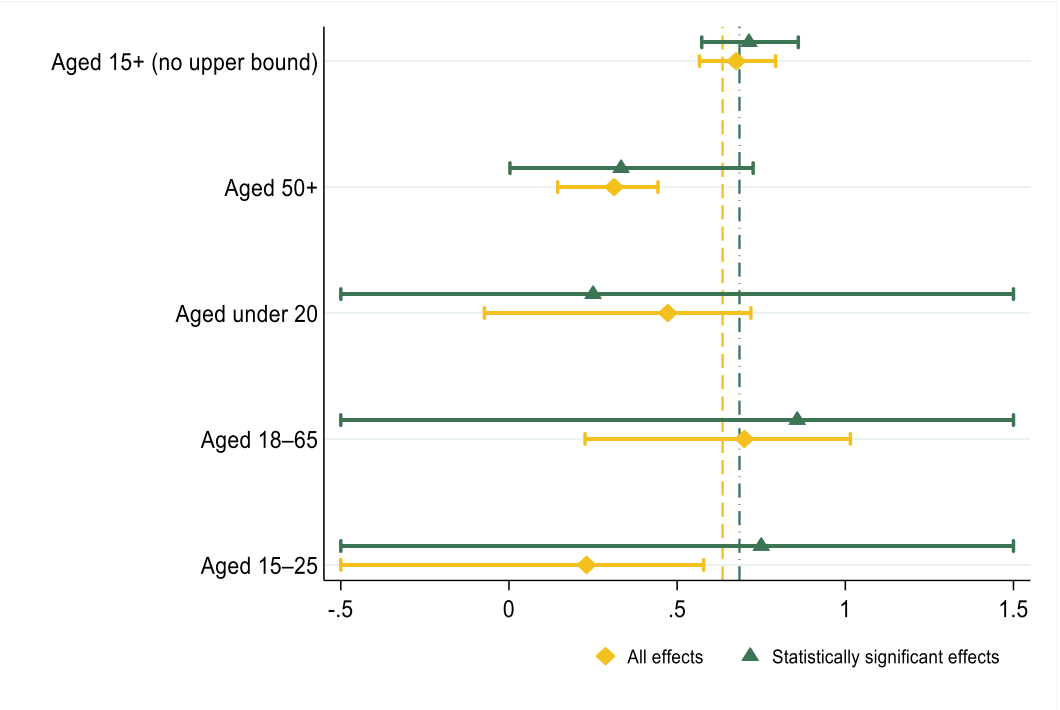
Source: Own analysis of literature review database.

Demographic breakdowns, as shown in Figure 2-3, suggest that rural advantage is less evident among those aged 49 or older (M_{all} = 0.313, 95% CI [0.145, 0443]) and young people (aged 15–25; M_{all} = 0.231, 95% CI [-0.515, 0.579]). However, the number of subgroup-specific studies is limited, and estimates are imprecise.

Geographic patterns, as shown in Figure 2-4, show that single-country studies from Central Europe less often report a rural advantage (M_{sig} = 0.222, 95% CI [-0.018, 0.370]), while multi-country studies tend to do so more frequently. However, this difference just failed to reach statistical significance (M_{sig} = 0.846, 95% CI [0.680, 0.992]). Given the lack of single-country effects reported for countries in the "Eastern European", "Balkan"[7] , and "small European countries" welfare state groups, we also tagged whether the multiple-country studies included countries from these welfare state groups. The results suggest that the inclusion or exclusion of any country within the tagged group does not impact the overall mean.

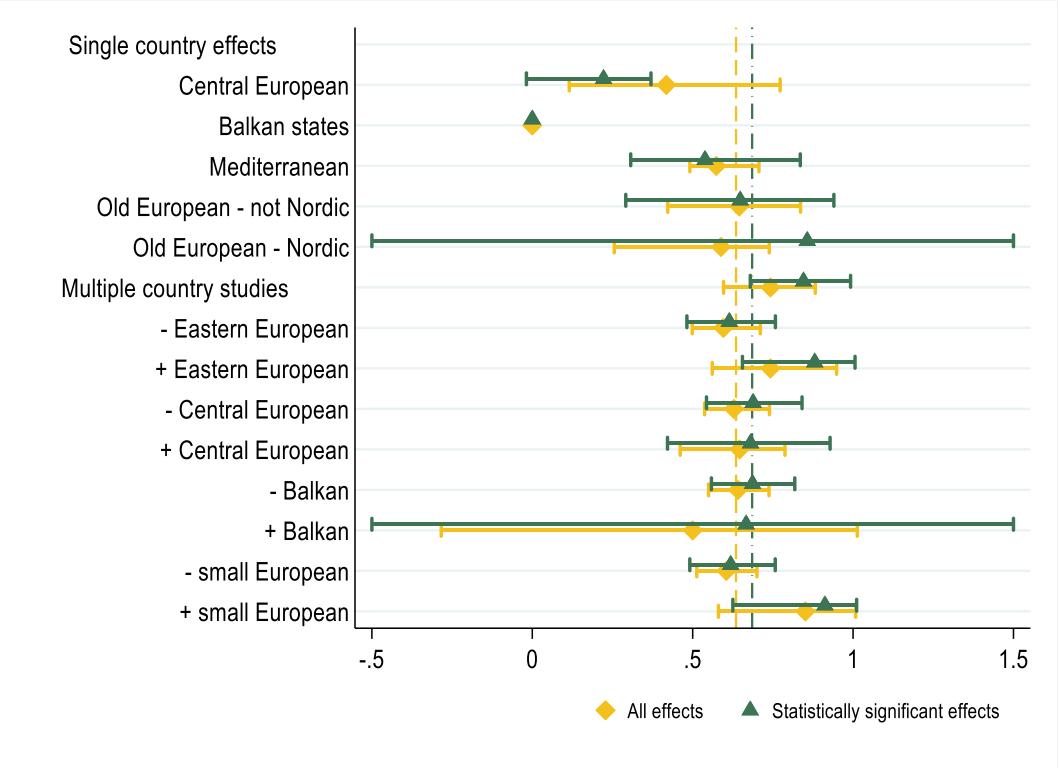
7 While we observe two studies that report rural area type effects for North Macedonia and Montenegro, respectively, wild bootstrap CIs cannot be reliably computed for sample sizes of less than N=3 or when there is no variation in the outcome variable. In this case, neither study reported a rural advantage. We refer the Reader to Appendix 2-1 for further details on why specific CIs are not reported.

Figure 2-3: Proportion rural advantage in subjective wellbeing, by age of the population studied



Notes: CIs capped at -.05 and 1.5 for ease of display. See **Appendix 2** (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

Figure 2-4: Proportion rural advantage in subjective wellbeing, by (groups of) countries studied



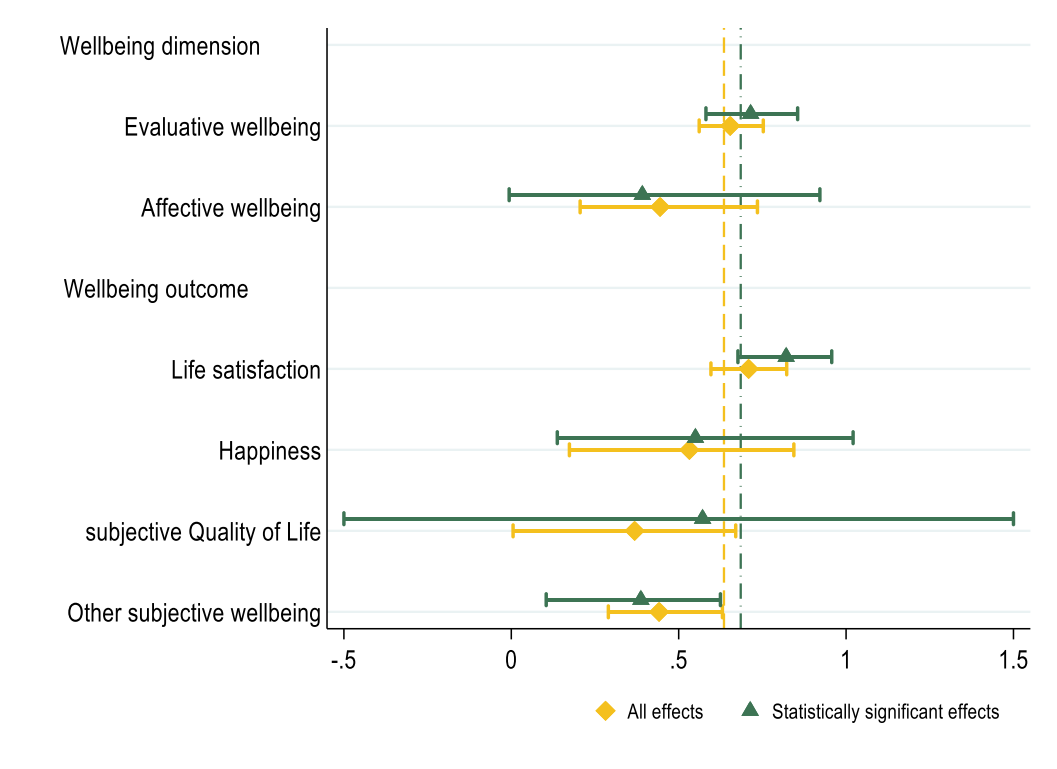
Notes: CIs capped at -.05 and 1.5 for ease of display. See Appendix 2 (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

2.2.3.2. Measurement of subjective wellbeing

The research on rural-urban differences in subjective wellbeing is dominated by the use of evaluative wellbeing measures, with 70 studies contributing 549 out of a total of 603 effects. Eighteen studies with 54 effects provided empirical results on how an affective wellbeing measure varies between rural and urban (or between different types of rural) areas. Life satisfaction measures are by far the most prevalent measures, with 51 studies contributing 426 effects. Next up are “Other subjective wellbeing” outcomes (23 studies with 111 effects).[8]

Figure 2-5 shows that the evaluative wellbeing outcomes have a slightly higher proportion of effects indicating rural advantage than the affective wellbeing outcomes. But the difference to the overall mean fails to reach statistical significance (evaluative wellbeing: M_{all} = 0.654, 95% CI [0.561, 0.753]; M_{sig} = 0.715, 95% CI [0.581, 0.855]; affective wellbeing: M_{all} = 0.444, 95% CI [0.206, 0.735], M_{sig} = 0.391, 95% CI [-0.006, 0.922]). The higher proportion of effects indicating rural advantage in the evaluative wellbeing dimension is driven by studies focusing on life satisfaction. Among the statistically significant effects based on life satisfaction as an outcome, rural advantage is found in 82.1% of effects (M_{sig} = 0.821, 95% CI [0.677, 0.957]). The group of studies examining "Other subjective wellbeing" evaluatively has a particularly low rate of effects indicating rural advantage in wellbeing (M_{all} = 0.441, 95% CI [0.290, 0.631]; M_{sig} = 0.387, 95% CI [0.104, 0.625]). Overall, therefore, the urban happiness paradox is essentially a paradox of urban life satisfaction.

Figure 2-5: Proportion rural advantage in subjective wellbeing, by wellbeing outcome studied



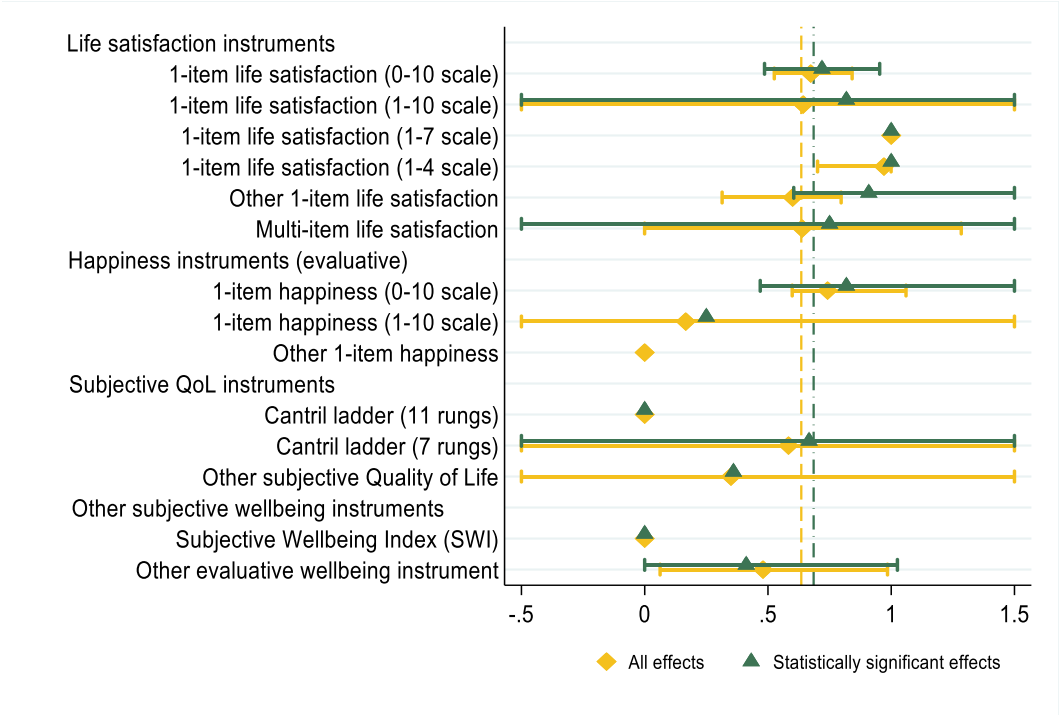
Notes: CIs capped at -.05 and 1.5 for ease of display. See **Appendix 2** (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

Figure 2-6 highlights the instruments measuring wellbeing and their connection to the rural wellbeing advantage. The 1-item life satisfaction scale (0 to 10) is the most frequently used evaluative wellbeing instrument, used in 27

8 We added to this group instruments that combine life satisfaction and happiness measures, or incorporate other components of well-being, such as meaning or purpose in life.

studies with 285 effects (e.g., Mollenkopf, Kaspar et al. 2004, Knies 2012, Ivlevs 2017).[9] Other 1-item scales (1-10, 1-7, 1-5, 1-4) and shorter versions focused on the most or least satisfied groups were used in fewer studies. Multi-item scales such as Diener's Satisfaction with Life Scale and Huebner's Students' Life Satisfaction Scale appeared in only five studies with 36 effects (e.g., Hooghe and Vanhoutte 2011, Podgorelec, Gregurović and Bogadi 2015, Róbert, Geszler and Nagy 2022). Global measures of happiness (0-10 and 1-10 scales) appeared in seven studies with 37 effects (e.g., Shucksmith, Cameron et al. 2009, Rodríguez-Pose and von Berlepsch 2014, Requena 2016). Subjective Quality of Life (QoL) measures were less frequently studied, with eight studies reporting 19 effects, the Cantril ladder being the most frequently used (e.g., Brereton, Clinch and Ferreira 2008, Eriksson, Hochwälder and Sellström 2011, Graham and Nikolova 2015).[10] Other measures fall into the miscellaneous category, and there is no single, widely used instrument for assessing affective wellbeing: 1-item happiness measures with response formats ranging from 0–10, 1–5, and 1–6 (condensed) each appeared in only one study. The Positive and Negative Affect Schedule (PANAS) and the General Health Questionnaire (GHQ-12) were used in two studies, the GHQ-12 yielding one of the highest instance counts (10 effects).[11] Seven studies (25 effects) used other affective wellbeing measures, reflecting the diversity of alternative measures used in wellbeing research.

Figure 2-6: Proportion rural advantage in subjective wellbeing, by wellbeing instruments studied



Notes: CIs capped at -.05 and 1.5 for ease of display. See Appendix 2 (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

9 The wording of life satisfaction questions varies slightly across studies (e.g., "nowadays", "currently", or "overall", and using scale endpoints like "complete", "total" or "extreme"), but we treat these as equivalent. Surveys such as the European Social Survey adjust wording across languages for conceptual comparability. We assume all Eurobarometer studies used the 10-point life satisfaction scale unless otherwise specified (cf. GESIS-Leibniz Institute for the Social Sciences n.d.).

10 The Cantril Self-Anchoring Striving Scale (Cantril 1965) is often presented as a life satisfaction instrument. Respondents are asked to imagine a ladder with steps numbered from zero at the bottom, representing the worst possible life, to 10 at the top, representing the best possible life. They then pick the number which represents the step of the ladder where they stand at this time. We consider it a measure of subjective Quality of Life. Also see Glatzer and Gulyas (2014).

11 GHQ-12 is a widely used screening tool for assessing mental health and psychological distress. We did not specify the measure as one of the general subjective well-being outcomes of interest that we specifically set out to include in the review. A future study may consider increasing efforts to incorporate GHQ-12-based studies into this literature review database.

As shown in Figure 2-6, among the evaluative wellbeing instruments, studies that use short 1-item life satisfaction scales have a particularly high rate of effects indicating a rural advantage. All effects based on studies using a 1-7 or a 1-4 life satisfaction scale indicate a rural wellbeing advantage (as there is no variation, there are no confidence intervals). Almost all statistically significant effects using "other 1-item life satisfaction scales" (which include condensed versions of the longer 10- or 11-point scales) report rural advantage (M_{sig} = 0.909, 95% CI [0.604, 1.655]). Conversely, none of the five studies that investigated differences in subjective Quality of Life using the Cantril ladder (both the longer 11-point scale and the shorter 7-point scale) reported a rural wellbeing advantage. While studies using 1-item happiness scales with 11-point scales report a high share of rural advantage (M_{all} = 0.742, 95% CI [0.598, 1.060]), those using shorter 1-10 scales report a lower share of rural advantage (M_{all} = 0.167, 95% CI [-2343612, 97651]), albeit the CIs are very large as this instrument is not used in many studies. There is no clear pattern regarding the role of affective wellbeing instruments in the rural wellbeing advantage; the number of studies reporting statistically significant effects is low (N = 18), as shown in **Appendix 2** (A2-2).

2.2.3.3. Operationalisation of Rural and Urban Areas

When recording the definitions of rural-urban areas used in the research, we followed Knies and Melo (2019) and distinguished between administrative definitions of rural-urban areas and survey-based definitions. We differentiate between classifications that describe the local context at geographical scales below the level of municipalities (e.g., postcodes or 1 km grids), at the scale of municipalities (e.g., LAU or NUTS5), and scales larger than municipalities (e.g., counties, NUTS3 or NUTS2). Additionally, some administrative classifications relate to built-up areas (e.g., aggregations of 100-metre grids or small-scale Census output areas, such as the UK rural-urban classification of output areas). Of the 80 studies in our review, 53 studies used administrative classifications (338 effects of which 126, or 37.3%, were statistically significant), and 31 studies relied on respondent- or interviewer-perceived classifications (265 effects of which 125, or 47.2%, were statistically significant). Within the administrative definitions, markedly higher shares of statistically significant differences in subjective wellbeing between rural and urban populations were reported in studies that used built-up areas (45 out of 98 = 45.9%) or below municipality-level (10 out of 20 effects = 50%) classifications. In comparison, the share is markedly lower for municipality-level (19 out of 65 = 29.2%) and above municipality-level (52 out of 155 effects = 33.6%) classifications.

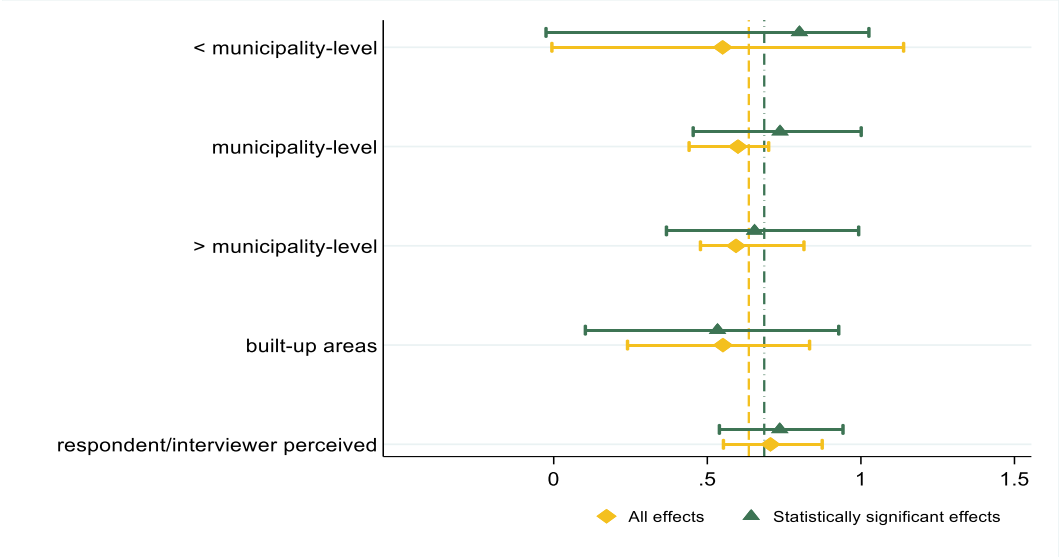
There is considerable heterogeneity in the area definitions used at these scales. For detailed results, see **Appendix 3** (A2-3). For example, among the six studies that measured rurality below municipality-level, one study used Eurostat's Degree of Urbanisation (DEGURBA)[12], two studies used population density, one used population-size bins, and a further two studies compared subjective wellbeing in specific small rural places with wellbeing in specific urban areas.[13] At the municipality level, researchers employed a wide range of measures—from continuous population density and nuanced population-size binning strategies to more complex definitions combining size or density with land use, economic structure, and proximity to urban centres. Interestingly, all studies that use population size bins or population density bins condense the classifications, most frequently creating a rural-urban binary. Above the municipality level, DEGURBA dominates—six studies applied it at the NUTS3 level (one condensing it into a rural-urban binary), yielding 103 separate effects, alongside population-based metrics (density or size bins), though no single measure prevails. Classifications of built-up areas tend to rely on settlement size bins, often condensed into binary rural-urban, with no specific measure standing out as providing a particularly high share of statistically significant results on rural-urban wellbeing differentials. Additionally, survey questions ask respondents (or interviewers) to classify the respondents' place of residence in terms of settlement type (e.g., open countryside, village, small town, mid-sized town or big city) and/or size (e.g., less than 10k inhabitants, more than 500k inhabitants). Settlement type, condensed to a simple rural-urban dichotomy, is the most frequently used

12 The research uses the original DEGURBA. It combines fine-grained population size and population density thresholds to establish three mutually exclusive classes (cities, towns and suburbs, and rural areas. For further information, see https://ec.europa.eu/eurostat/web/degree-of-urbanisation/information-data.

13 While it is common to compare well-being in different rural localities, due to data protection legislation, the research does not usually provide detailed information about population size or other parameters we need for this review. Hence, our review database does contain very few studies of this type.

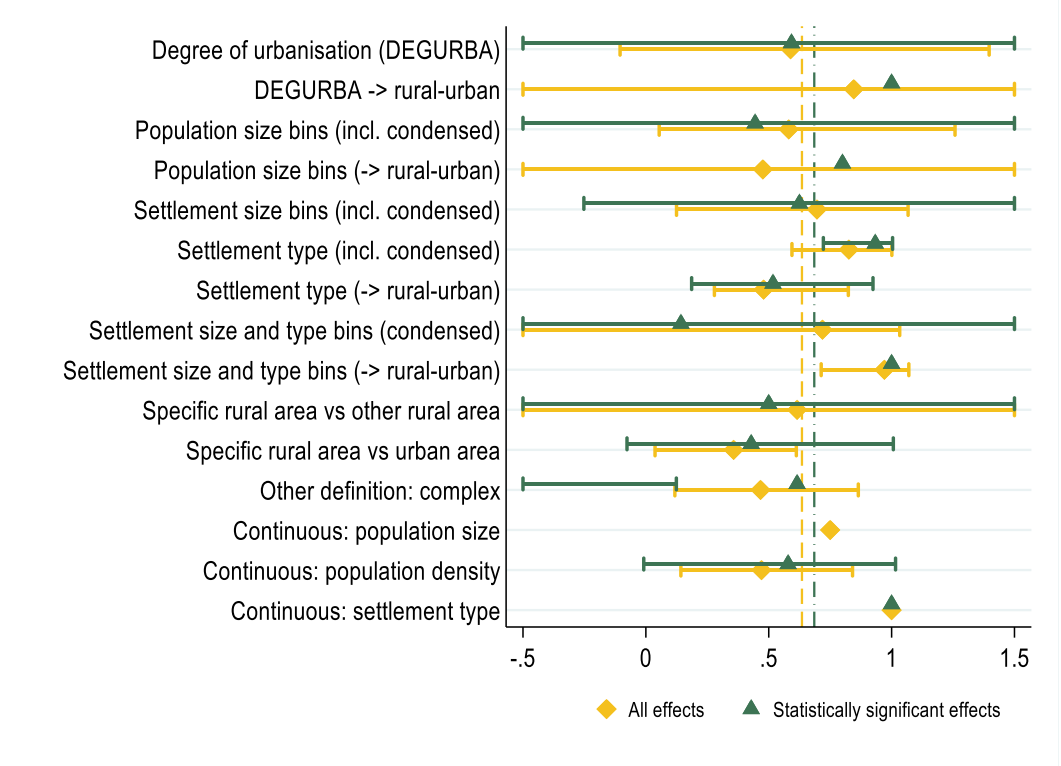
instrument in this “respondent/interviewer-perceived” category, with 15 studies and 89 reported effects (of which 56, or 62.9%, are statistically significant). This suggests a strong preference for binary or condensed classifications when relying on respondents' assessments. A reason for this is that general population studies typically do not include large enough samples of individuals from all types of settlements.

Figure 2-7: Proportion rural advantage in subjective wellbeing, by geographic scale of effects studied



Source: Own analysis of literature review database.

Figure 2-8: Proportion rural advantage in subjective wellbeing, by area classification utilised



Notes: CIs capped at -.05 and 1.5 for ease of display. See **Appendix 2** (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

As shown in Figure 2-7, above, no statistically significant differences were found between the geographical scale subgroups. This suggests that the observed rural advantage does not systematically depend on the geographical scale at which rurality is measured. By contrast, as shown in Figure 2-8, above, statistically significant rural advantages in wellbeing are observed when we consider the way rurality is operationalised. Statistically significant associations with a reported rural wellbeing advantage are observed when rurality is operationalised as “settlement type” (M_{sig} = 0.933, 95% CI [0.722, 1.004]), dichotomised “settlement size and type bins” (M_{all} = 0.972, 95% CI [0.713, 1.070]; M_{sig} = 1, 95% CI [-∞, +∞]), or dichotomised DEGURBA (M_{sig} = 1, 95% CI [-∞, +∞]). For completeness, we report the rural wellbeing advantage results by geographical scale and rurality measurement, as shown in Appendix 3 (A2-3).

2.2.3.4. Rural base categories

We organised base and comparison pairings by the characteristics of the base categories. Area definitions involving population size were grouped by whether they fell below a 10k or 20k inhabitant threshold. For example, the “<10k inhabitants” category includes all definitions referring to settlements, municipalities or places with fewer than 2k, 5k or 10k inhabitants, while “<20k inhabitants” includes definitions using thresholds of up to 20k (e.g., municipalities with 5k-15k inhabitants). For classifications not based on population size, we differentiated between those mentioning the specific rural settlement types “farm", "open countryside", or "hamlet" and those mentioning more general rural settlements (e.g., "farm, countryside or village", "village", or "rural area"). The latter were further split by whether "small towns" were mentioned. We also grouped the urban (or less rural) comparison categories by population size or settlement type. Note that these categories are ambiguous: towns or cities can have small populations, and some villages are considered towns in all but their official status. As a general rule, we considered places with > 10k inhabitants as urban. However, we still distinguish between spatial scales - a municipality with just over 10k inhabitants might include several small villages, while a town of the same size may be a single settlement.

As shown in Table 2-10 (for complete results see Appendix 3 (A2-3)), most studies use population thresholds to characterise areas as rural or urban. Specifically, a threshold of less than 10k inhabitants is most common, used in 21 studies with 142 effects (e.g., Spellerberg, Huschka and Habich 2007, Carta, Aguglia et al. 2012). A threshold straddling the 10k mark and below 20k inhabitants is less frequently used, appearing in two studies with 29 effects (Bergstad, Gamble et al. 2012, Lehberger, Kleih and Sparke 2021). A sizeable number of studies rely on settlement-based categories. “Rural area/settlement (not including small towns)" is used in 21 studies with 97 effects (e.g., Kountouris and Remoundou 2011, Laurence 2019, Ivanović, Šimac and Trako Poljak 2022), while rural area is defined as "farm" and/or "countryside" and/or "hamlet" in eight studies with 54 effects (e.g., Ory and Huijts 2015, Ivlevs 2017, Huebner, Oreszczyn et al. 2022). Seven studies (43 effects) used references to small towns in the definition of rural areas (e.g., Mollenkopf, Kaspar et al. 2004, Shucksmith, Cameron et al. 2009, Blekesaune and Haugen 2018). The “sparsely populated” (“rural” or “non-urban”) category of the DEGURBA is used in 10 studies with 123 effects (e.g., Navarro, D'Agostino and Neri 2020, Methorst, Rehdanz et al. 2021, Keller, Groot et al. 2022), making it the most common base category in the literature review database. More specific definitions, such as "remote rural” (Ek, Koiranen et al. 2008) and “national parks” (Jones, Malesios et al. 2020, Wiesli and Przepiorka 2023), are rare in our literature database. Schilling and Wahl (2002) use the German (predominantly) population size-based BIK classification, recoding settlements of all sizes to “rural” if they are located in peripheral (i.e., commuting-wise not well-connected) BIK regions. The "<10k inhabitants" category is present at the below-municipality, municipality, and built-up area geographical scales, and it is also used in respondent/interviewer-perceived classifications. Ten studies use it at the built-up area level (55 effects, 27 of which, or 49%, are statistically significant), and five studies at the municipality level (23 effects, six of which, or 21.1%, are statistically significant). The DEGURBA base category "sparsely populated area" is used at all administrative scales, contributing most effects at the above municipality level (102 effects from six studies, but only 30 statistically significant effects). Among the survey-response-based perceived classifications, the "rural settlement farm, countryside or hamlet" category is frequently used, with seven studies contributing 51 effects, of which 38 are statistically significant. Eighteen studies with 88 effects define rural as "rural settlement" or "rural area", not mentioning small towns in the definition. A high proportion of the reported effects is statistically significant (52 out of 88, or 59.1%). By contrast, if the definition of rural is based on administrative classifications that include "small town" in the definition of a rural area or settlement,

there are only five studies, and only eight of the reported 24 effects are statistically significant (eight out of 24, or 33.3%).

Table 2-10: Rural base categories by geographic scale of the administrative area classification

Scale	Definition	All effects		Statistically significant effects	
		# of studies	# of effects	# of studies	# of effects
< municipality	<10k inhabitants	3	4	3	4
	Sparsely populated area (DEGURBA)	1	12	1	5
	Continuous: Population density	2	4	1	1
Municipality	<10k inhabitants	3	20	1	5
	<20k inhabitants	1	1	1	1
	Sparsely populated area (DEGURBA)	2	5	1	2
	Rural area/municipality/settlement (small town)	3	14	2	5
	Continuous: Population density	1	2	1	1
	Remote rural	1	8	1	4
> municipality	Sparsely populated area (DEGURBA)	6	103	4	30
	Rural area/municipality/settlement (small town)	1	3	1	1
	Continuous: Population density	6	27	5	17
	Continuous: Population size	1	4	0	0
	Other continuous measure	2	7	1	2
	National park	1	11	1	2
built-up areas	<10k inhabitants	10	55	7	27
	Sparsely populated area (DEGURBA)	1	4	1	4
	Rural settlement: Farm, countryside or hamlet	1	3	1	1
	Rural area/settlement (not small town)	3	9	2	6
	Rural area/municipality/settlement (small town)	1	7	1	2
	Continuous: Population density	1	1	0	0
	Other continuous measure	1	3	1	2
Respondent/interviewer perceived	<10k inhabitants	5	63	3	12
	<20k inhabitants	1	28	0	0
	Rural settlement: Farm, countryside or hamlet	7	51	7	38
	Rural area/settlement (not small town)	18	88	10	52
	Rural area/municipality/settlement (small town)	2	19	1	11
	Continuous measure	2	14	1	10
	National park	1	2	1	2

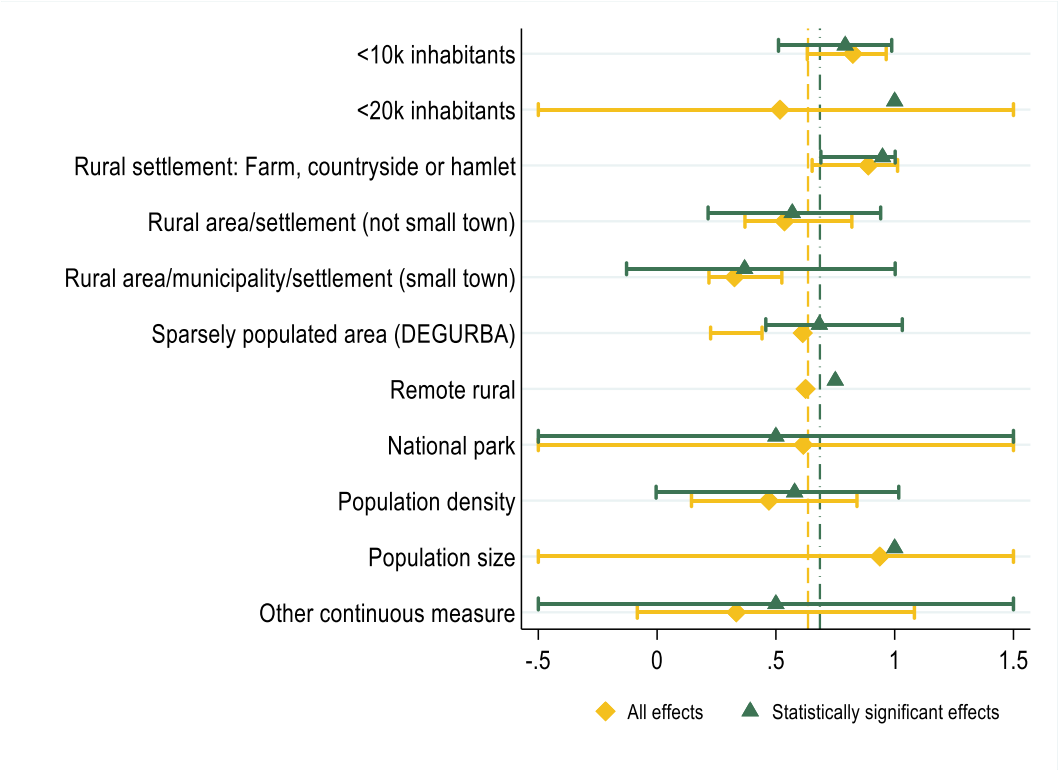
Notes: For comprehensive results, including associations with the rural advantage in subjective wellbeing, see Appendix 3 (A2-3).
Source: Own analysis of literature review database.

As shown in Figure 2-9, when rural areas were defined as having fewer than 10k inhabitants, 82.4% of all effects indicated rural advantage (M_{all} = 0.824, 95% CI [0.632, 0.964]), and 77.6% of the statistically significant effects did so as well (M_{sig} = 0.792, 95% CI [0.511, 0.987]). The strongest positive association appeared when rural areas were described as "farm, countryside or hamlet": 88.9% of all effects (M_{all} = 0.889, 95% CI [0.652, 1.012]) and 94.9% of significant effects (M_{sig} = 0.949, 95% CI [0.689, 1.002]) indicated a rural wellbeing advantage. In contrast, when the definition of rural areas included small towns, rural advantage was much lower: only 32.6% of effects overall (M_{all} = 0.326, 95% CI [0.218, 0.525]) and 36.8% of statistically significant effects (M_{sig} = 0.368, 95% CI [-0.129, 1.002]) indicated a rural advantage. Albeit none of the subgroup differences reached statistical significance.

There are only two studies that use population size to capture rural-urban differences; they find a higher rate of rural wellbeing advantage, but the CIs are huge, due to the scarcity of measurement points (M_{all} = 0.938, 95% CI [-48824, 2035]). Otherwise, there is some indication that studies that use continuous measures to operationalise rural-urban differences in wellbeing find no rural wellbeing advantage. For example, only 47.1% of the effects based on population density show a rural wellbeing advantage (M_{all} = 0.471, 95% CI [0.142, 0.841]) and 33.3% of effects

based on other continuous measures (such as when settlement type categories are used as a continuous measure; M_{all} = 0.333, 95% CI [-0.417, -0.188]).

Figure 2-9: Proportion rural advantage in subjective wellbeing, by rural base category studied



Notes: CIs capped at -.05 and 1.5 for ease of display. See **Appendix 2** (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

2.2.3.5. Urban (or less rural) comparison categories

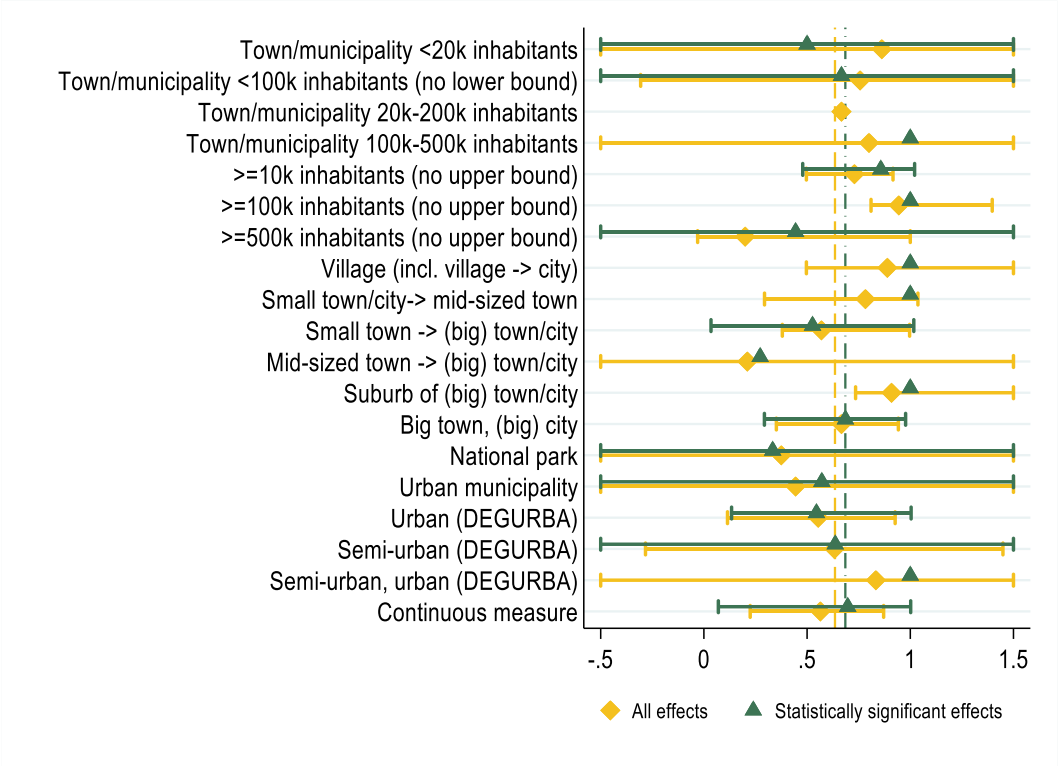
The most common urban comparison category group is "> 10k inhabitants (no upper bound)", appearing in 18 studies with 85 effects (e.g., Bonomi Bezzo, Silva and van Ham 2021, Gschwandtner, Jewell and Kambhampati 2022, Hoogerbrugge and Burger 2022). Other widely used thresholds include "towns/municipalities with < 100k inhabitants" appearing in five studies with 37 effects (e.g., Hayo 2004, Marcellini, Giuli et al. 2007, Checa and Nel·lo 2021) and "> 500k inhabitants"[14]- appearing in five studies with 25 effects (Gerdtham and Johannesson 2001, Murray, Maddison and Rehdanz 2011, Knies, Melo and Zhang 2020, Checa and Nel·lo 2021). Among urban comparison categories that do not use population size, larger urban categories, such as "big towns or cities", are represented in 13 studies with 45 effects (e.g., Efklides, Kalaitzidou and Chankin 2003, Requena 2016, Laurence 2019). Many studies combine multiple urban settlements in one category; the "small town to (big) town/city" category is prominent (11 studies and 72 effects, e.g., Tobiasz-Adamczyk and Zawisza (2017), Ivanović, Šimac and Trako Poljak (2022)), while “mid-sized towns to (big) cities” appear in two studies with 19 effects (Shucksmith, Cameron et al. 2009, Bartlett, Cipusheva et al. 2010). Four studies with nine effects merged villages with the urban category (Ferreira, Akay et al. 2013, Rodríguez-Pose and von Berlepsch 2014, Requena 2016, Hanell 2022). Regarding the DEGURBA classification, two studies (12 effects) merged the semi-rural category with the urban category, and 10 studies report rural-urban effects (N = 65). In comparison, five studies report rural-semi-urban effects (N=49, e.g., Silva and Brown (2013), González-Carrasco, Casas et al. (2019), Schmid, Christmann et al. (2023)). Suburban

14 We included specific cities such as London, Barcelona, Berlin and Stockholm in this category.

settlements are compared with rural settlements in four studies, which identify 11 effects (Ferreira, Akay et al. 2013, Rodríguez-Pose and von Berlepsch 2014, Requena 2016, Hanell 2022).

As shown in Figure 2-10, some urban comparison groups show uniform outcomes—either a 100% rural advantage (e.g., “Village (incl. village -> city)”, “Small town -> mid-sized town”) or no rural advantage at all (e.g., “Mid-sized town -> (big) town/city”)—although these likely reflect small sample sizes. Among all effects, rural advantage is statistically more frequently observed when compared to residents of “Suburbs of big cities” (M_{all} = 0.909, 95 % CI [0.735, 1.516]; M_{sig} = 1, 95 % CI [-∞, +∞]) and urban areas with “>=100k inhabitants” (M_{all} = 0.944, 95 % CI [0.810, 1.397]; M_{sig} = 1, no CI definable).

Figure 2-10: Proportion rural advantage in subjective wellbeing, by urban (and less rural) comparison category



Notes: CIs capped at -.05 and 1.5 for ease of display. See **Appendix 2** (A2-2) for values of the computed wild bootstrap CIs.
Source: Own analysis of literature review database.

Overall, the findings suggest that the way rural and urban areas are defined—particularly whether villages and small towns are included in the rural category—impacts the observed differences in rural-urban wellbeing. However, the significant variation in definitions makes it difficult to identify which specific comparisons between rural and urban areas are linked to the rural advantage in subjective wellbeing.

2.3. Discussion

Our systematic review reveals a consistent, albeit nuanced, rural wellbeing advantage in subjective wellbeing across the literature. Overall, 63.5% of all reported effects and 68.5% of statistically significant effects indicate that people living in Europe have higher subjective wellbeing in rural than in urban settings. This pattern, often termed the "urban happiness paradox", appears most pronounced when wellbeing is measured evaluatively, particularly via 1-item life satisfaction scales (e.g., 0–10; 1–7-point scales), where rural advantage accounts for over 80% of the statistically significant effects. In contrast, affective wellbeing measures (e.g., mood or emotion-focused scales) show a weaker and more variable rural advantage (approximately 44% across all effects). Thus, the paradox is driven primarily by

evaluative life satisfaction, suggesting that rural residents, on average, report higher cognitive appraisals of their lives even if moment-to-moment emotions do not differ as clearly.

We observe considerable heterogeneity in the prevalence of rural advantage, depending on how "rural" and "urban" are defined. Studies employing fine-grained respondent-perceived rural definitions, such as "farm, countryside or hamlet," report rural advantages in nearly 90% of effects, whereas definitions that include small towns in the rural category show rural advantage in fewer than 35% of effects. Likewise, continuous measures, such as population density, yield mixed results, with a rural advantage in fewer than half of the observed effects. These findings underscore that the observed wellbeing differential is sensitive to operationalisation choices and that the most parsimonious binary definitions may inflate rural advantages.

Our geographic analysis highlights a regional bias in the literature. Mediterranean countries (notably Spain and Italy) dominate the evidence base, whereas Eastern Europe and small European states are notably underrepresented in single-country studies. Although multi-country pooled studies sometimes include these regions, their heterogeneous welfare contexts (e.g., post-socialist transitions) remain understudied. Temporally, the rural advantage was especially marked in studies covering periods before 2000 and after 2020, although confidence intervals are wide, and sample sizes in the latter period remain small. Age-specific analyses suggest a diminished rural advantage among older adults (over 49), while evidence for younger cohorts is too sparse for firm conclusions.

Finally, our review reveals a scarcity of research on the effects of rural context. There were very few studies that included additional information on characteristics of the rural areas studied and their impact on wellbeing. Only eight studies (27 effects) address how rural wellbeing evolves with changing contextual factors (e.g., economic development, demographic shifts), limiting our ability to unpack the mechanisms underpinning the rural advantage.

2.4. Conclusion and outlook

Our review confirms a robust rural evaluative wellbeing advantage, driven primarily by life satisfaction measures and sensitive to area definitions. The use of diverse measurement instruments, definitions, and small numbers of effects in subgroups results in wide confidence intervals, which limit statistical power. Although a sizable number of studies used longitudinal panel data, few exploited the opportunities afforded by these study designs to investigate changes over time, let alone address the methodological challenges that hinder the identification of causal effects of place on subjective wellbeing (Knies, Melo and Zhang 2020).

To deepen our understanding of this phenomenon and enhance its generalisability, future research should expand geographic coverage, particularly in underrepresented welfare regimes such as Eastern Europe, smaller European nations, and Balkan states. Researchers should also standardise measurement approaches by combining evaluative and affective wellbeing instruments and exploring multi-item scales to improve cross-study comparability. Attention should be given to subgroup heterogeneity, with a focus on age, gender, and socio-economic stratification, to identify which population segments benefit the most or the least from rural living.

Additionally, future studies should explore continuous and nonlinear relationships, such as the potential for "sweet spots" in population density or proximity to urban centres. It is also important to integrate analyses of rural context effects, examining how changes in infrastructure, economic opportunities, and demographic composition influence rural wellbeing over time. Finally, linking subjective wellbeing data with specific policy initiatives—such as rural development programs, digital connectivity efforts, and environmental policies—can help assess their impact.

By addressing these gaps, research can progress beyond simply documenting rural–urban differences in wellbeing and move toward a deeper understanding of the mechanisms, causal pathways, and policy implications that shape these outcomes.

3. Rural wellbeing: Subjective wellbeing across European Countries and Settlement Types

3.1. Introduction

Subjective wellbeing (SWB) is a multidimensional concept that has been studied initially in the fields of happiness economics and positive psychology (see Huppert and So 2013). However, the increasingly multidisciplinary research has ventured down the avenue of studying not only affective wellbeing (e.g., self-reported mood states) and evaluative wellbeing (e.g., satisfaction with life questions), but also considers psychological functioning (e.g., the degree to which basic psychological needs are satisfied) as a key ingredient to human flourishing (Fabian 2022, Martela, Delle-Fave et al. 2023). Mental resources, too, play a key role in influencing flourishing, defined as "(a) combination of feeling good and functioning effectively" (Huppert and So 2013, p.838). Optimism, for example, "heavily influences physical and mental health, as well as coping with everyday social and working life" (Conversano, Rotondo et al. 2010, p.28).

Our systematic review of the empirical literature on rural-urban and rural-rural differences in subjective wellbeing has highlighted that findings on rural subjective wellbeing are still largely based on analyses of 1-item happiness and life satisfaction measures. To close the knowledge gap, we set out to examine rural-urban and rural-rural differences in further dimensions of subjective wellbeing indicated in the wellbeing research. Such analysis is timely, not least because the GRANULAR project coincides with the development of a designated "Personal and Social Wellbeing" module to be rolled out in Round 12 of the ESS, which is scheduled to take place across Europe in 2025/2026.

3.1.1. Theories and debates on rural-urban differences in wellbeing

While there is a plethora of research on rural-urban differences in objective wellbeing, including the use of multidimensional measures thereof (Voukelatou, Gabrielli et al. 2020), there is much less research examining rural-urban differences in subjective wellbeing (Wang and Wang 2015, Lolle 2023). Intriguingly, quantitative research into rural-urban differences in subjective wellbeing has found, overall, support for a rural wellbeing advantage (see Chapter 2 above; Burger, Morrison et al. (2020), Okulicz-Kozaryn and R. Valente (2021), Sorensen (2021)). While the findings of higher SWB in rural areas are in line with the widely held perception of the "rural idyll" (Shucksmith 2018), they stand in contrast to research on rural areas as left behind places and breeding ground of populist unrest (for an overview of the development of the concept and current research, see Pike, Béal et al. (2023)) and research focussing on rural-urban differences in objective wellbeing (particularly, higher rates of poverty (Augère-Granier 2017) - particularly for women (Eurostat 2022) - and issues of affordable housing (Shucksmith 2018)). In economic theory, cities allow for several advantages of agglomeration, such as more efficient labour markets, greater innovative capacity, and more knowledge spill-overs and such positive externalities enhance capacity utilisation and reduce the cost per unit of production (see, e.g., Marshall 1890, Duranton and Puga 2004, Henderson and Mills 2014), which can explain economic disadvantage of rural areas compared to cities. Albeit, there is a great deal of heterogeneity in findings and some indication of context specificity. Higher rural poverty, for example, is more prevalent in countries where rural areas are sparsely populated, farming is more common, living standards are generally lower, and in post-socialist countries (Bernard 2019). Sánchez-Sellero, García-Carro and Sánchez-Sellero (2021) also found no rural-urban differences in the socio-economic and environment components of subjective quality of life (which, at the individual level, are highly correlated with global measures of life satisfaction). In the more societal components (i.e., the public services and governance components) of quality of life (which are often not considered in the research on life satisfaction), by contrast, there were statistically significant differences across the rural-urban continuum (also see Küpper and Seel 2022 who show that positive evaluations of the quality of local cultural places, restaurants and sports facilities are the strongest correlates of local life satisfaction in Germany).

Theoretical arguments for a rural advantage in wellbeing can be traced back to the beginning of the Industrial Revolution and urbanisation. On the one hand, in the 18th Century, intellectuals such as Adam Smith (returning to

his childhood home in rural Kirkcaldy after years of teaching in Glasgow) serenated the beauty, pleasures, and tranquillity of life in the countryside (Berry and Okulicz-Kozaryn 2009). Happiness researchers suggest that there is a socio-biological component to human preferences for living in smaller communities and closer to nature (Veenhoven 1994). Notwithstanding an apparent over-idealisation of country life (Veenhoven 1994, Shucksmith 2018), empirical studies have found support for the positive impacts of access to green space on stress exposure and coping (van den Berg, Maas et al. 2010), as well as physical health and psychological wellbeing (Wolch, Byrne and Newell 2014). Similarly, Sorensen (2014) finds that access to natural amenities is a significant predictor of rural wellbeing advantages and is also an important contributor to variation within urban areas (also see Ambrey 2016). A parallel to these longstanding theories emerged during the COVID-19 pandemic, when many urban residents relocated to scenic, nature-rich regions—an implicit demonstration of the same inherent pull toward restorative rural environments posited by 18th and 19th-century thinkers (González-Leonardo, López-Gay et al. 2022). On the other hand, the eroding effects of urbanism on social life and social trust were outlined (Tönnies 1887). They became, for example, codified as a general mechanism of social ill in the social disorganisation theory of the Chicago School (e.g., Wirth 1938) and the Shefky and Bell models of social areas (e.g., Bell and Force 1956). Moreover, epidemiological research in the USA up to the 1970s supported the assumption of rural wellbeing and urban malaise when measured using mental health indicators (Armstrong 1991). Research by Burger, Morrison et al. (2020) finds that in Northern Europe, Western Europe and the Anglo-Saxon countries, one of the factors explaining higher rural happiness is community attachment.[15] In all likelihood, therefore, we would expect rural-urban differences to be more pronounced in the dimensions of social wellbeing and psychological functioning than in evaluative wellbeing.

While economic theory has stressed the positive role that cities can play in peoples' lives - diverse kinds of people meet, new ideas emerge, cultural events are plenty, educational institutions are prevalent, businesses strive, employment opportunities are varied, etc. (e.g., Glaeser 2011) - more generalised theories argue that an overall opportunity structure for human flourishing needs to consider economic opportunities, public and private services, opportunities for community and civic engagement, and the accessibility of the natural and built environment (Bernard, Steinführer et al. 2022), i.e., suggesting a focus on a greater range of spaces and a move away from the urban rural dichotomy, which we still find in much of the empirical literature (see, e.g., chapter 2 in this report). In this view, individual preferences for small-town and rural living are balanced with the need for employment and access to other amenities of urban life, suggesting a potential advantage of suburban or, especially, rural and small-town living in commuting distance from urban centres (Fuguitt and Brown 1990, Biagi and Meleddu 2023, Finnemann, Huth et al. 2024). This position corresponds closely with migration flows away from more remote rural regions and urban centres, leading to population accumulations in accessible rural areas (Shucksmith 2012). Indeed, theory and some empirical research point towards a "sweet spot" of rural-urban balance (Lenzi and Perucca 2020, Hoogerbrugge, Burger and Van Oort 2022). Finnemann, Huth et al. (2024) find that while urban areas in the United Kingdom show lower degrees of life satisfaction, there are optimal distances – defined as the radius in which population average life satisfaction is highest on average and shows the least variation - which "tend to cluster in the hinterlands of cities". The potential of suburban or small-town and small-city advantages is also supported by Biagi and Meleddu (2023), focusing on Italy. The authors conclude that "it is not living in rural areas per se that guarantees a higher life satisfaction but actually living in rural areas where labour, leisure, social relations and access to amenities are more elevated in terms of availability and quality compared to other areas" (cf. Weckroth and Kemppainen 2021, who find no support for the "Sweet spot" hypothesis using data for a greater range of EU countries).

In conclusion, several studies and theories suggest that research on rural-urban differences in wellbeing should consider non-binary rural-urban classifications, ideally differentiating between different types of rural settlements and using nuanced definitions of wellbeing, as this may help uncover pathways to improving wellbeing in diverse contexts.

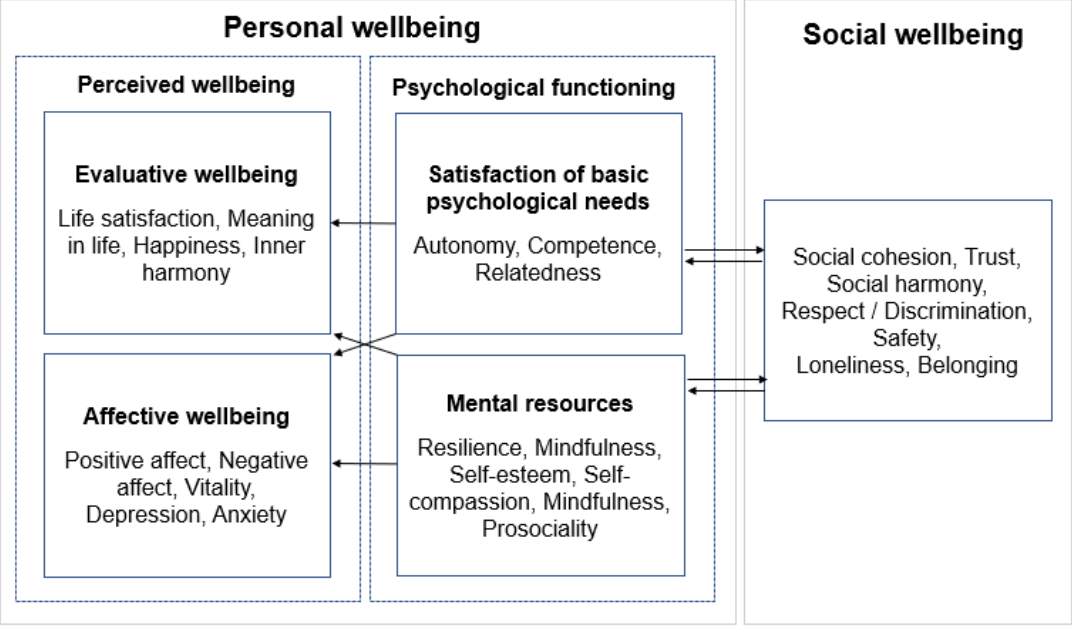
15 However, researchers have questioned whether lower levels of SWB in cities are really due to weaker social ties and trust or simply due to concentration of negative structural factors such as poverty (Fischer 1973; Okulicz-Kozaryn & Mazelis, 2018).

3.1.2. Wellbeing as subjective experience

Subjective wellbeing is a complex concept that relates to optimal experience and functioning. There are two main theoretical perspectives on subjective wellbeing. The first is the hedonic approach, which emphasises happiness and defines wellbeing in terms of the pursuit of pleasure and the avoidance of pain (e.g., Waterman 2008). Subjective evaluations of life, such as life satisfaction and subjective quality of life, are prominent outcomes studied under the umbrella of the hedonic wellbeing approach. The second is the eudaimonic approach, which emphasises meaning and self-realisation and defines wellbeing by the extent to which a person is fulfilling their potential and identifying meaningful pursuits in life (e.g., Waterman 2007). The two approaches are not straightforwardly integrated, and research findings are heterogeneous, in some cases conflicting (Ryan and Deci 2001).

In their proposal to repeat a revised comprehensive module on "Personal and social wellbeing" on Round 12 of the European Social Survey (ESS), Martela, Delle-Fave et al. (2023) provide an integrative wellbeing framework that builds on self-determination theory (Ryan and Deci 2017) and the previous module developed by Huppert, Marks et al. (2010). In the framework, personal wellbeing comprises psychological functioning and experienced wellbeing and is complemented by social wellbeing (i.e., the quality of the social environment in which individuals operate), see Figure 3-1. The scholars stress the importance of satisfaction of basic psychological needs - like autonomy (feeling in control of one's life), competence (feeling capable), and relatedness (having supportive relationships) - and mental resources related to human flourishing -such as resilience (staying mentally healthy during tough times), mindfulness (noticing and understanding one's emotions), optimism (having positive expectations for the future), and prosocial behaviours (helping and supporting others) – for personal wellbeing, and, via the individual's interaction with their environment, for social wellbeing.

Figure 3-1: Conceptual framework for dimensions of subjective wellbeing.



Source: Figure adapted from Martela, Delle-Fave et al. (2023).

As regards the factors leading to optimal experience and functioning, three perspectives have been identified (Brief, Butcher et al. 1993). The bottom-up approach builds on the philosophical assumption that there are universal needs that must be met for people to be happy. The settlement of needs is thought to be dependent upon external factors, and people who find themselves in a 'good situation' for the fulfilment of needs are happy, while those who find themselves in a 'bad situation' are unhappy (see, e.g., Diener, Suh et al. 1999). The context in which individuals can be happy is implicitly thought to be the same for everybody, and people will be happier the more moments of happiness they experience. It follows from this that the independent variables employed in bottom-up models are

objective life circumstances (providing a theoretical link also to objective wellbeing factors frequently used to monitor population wellbeing, see, e.g., the GRANULAR rural wellbeing compass).

As regards the factors leading to optimal experience and functioning, three perspectives have been identified (Brief, Butcher et al. 1993). The bottom-up approach builds on the philosophical assumption that there are universal needs which have to be met for people to be happy. The settlement of needs is thought to be dependent upon external factors, and people who find themselves in a 'good situation' for the fulfilment of needs are happy, while those who find themselves in a 'bad situation' are unhappy (see, e.g., Diener, Suh et al. 1999). The context in which individuals can be happy is implicitly thought to be the same for everybody, and people will be happier the more moments of happiness they experience. It follows from this that the independent variables employed in bottom-up models are objective life circumstances. An alternative philosophical theory to understanding happiness is the so-called top-down approach. These models assume that subjective wellbeing is influenced by characteristics that are internal to the individual. Among the factors these models include are personality traits such as determination, optimism, and self-confidence. Moreover, a person–environment fit perspective suggests that the congruence between an individual's attributes and their environmental demands also shapes subjective wellbeing: when personal traits "fit" the context, people report higher happiness, whereas misfit can undermine wellbeing (Götz, Ebert and Rentfrow 2018, Morrison and Weckroth 2018, Hanell 2022). While some characteristics, such as employment, health, and marital status, will play a role in the top-down models, the focus will be on the subjective evaluations of these states rather than the objective states. Last but not least, the third type of models acknowledges the multiple interactions between the internal and external context in which individuals operate. The so-called interactionist models recognise, for instance, that married people are happier than non-married people, but also that more optimistic and happier people are more likely to get married.

3.1.3. Empirical research on correlates of SWB

The bulk of the quantitative empirical research has focused on life satisfaction, as also seen in the research on rural-urban differences in the wellbeing of the population living in European rural areas (see Chapter 2). Research on life satisfaction has ascertained a number of interesting and consistent relationships between individual characteristics and life satisfaction (Layard 2005, Dolan, Peasgood and White 2008, Kaiser and Oswald 2022). First, life satisfaction exhibits a U-shaped pattern with age, with life satisfaction typically being at its lowest in midlife (e.g., Blanchflower and Oswald 2008, Kaiser, Otterbach and Sousa-Poza 2022). Second, unemployment (Clark and Oswald 1994) and a lower level of financial wellbeing (see, e.g., Easterlin 1974, Frijters, Haisken-DeNew and Shields 2004) are associated with lower life satisfaction. Third, people who are married are more satisfied with life than never-married singles, divorcees (including those living in separation) and widowers (see, e.g., Shapiro and Keyes 2008). A further consistent finding is that individuals who belong to a religion tend to be more satisfied with their lives (Lim and Putnam 2010). Lastly, it has been found that markers of poor health are significant factors in explaining lower self-reported levels of life satisfaction (Brief, Butcher et al. 1993, Diener, Suh et al. 1999). Diener and Chan (2011) demonstrate that happier individuals also tend to live healthier and longer lives. Findings concerning other individual characteristics typically included in life satisfaction models (such as sex, education, and the number of children in the household) are mixed (Frijters, Haisken-DeNew and Shields 2004).

Research examining various dimensions of subjective wellbeing is currently sparse, and systematic reviews on this topic are not yet available. The few available studies that examined multiple dimensions of subjective wellbeing in a comparative framework have shown the usefulness of these conceptualisations in capturing domain-specific differences in SWB across countries and regions (Huppert and So 2013, Ruggeri, Garcia-Garzon et al. 2020, Martela, Lehmus-Sun et al. 2023). A consistent finding from these studies is that countries that score similarly on life satisfaction can differ significantly on other dimensions of subjective wellbeing (Huppert and So 2013, Ruggeri, Garcia-Garzon et al. 2020). For example, Huppert and So (2013) found that Germany, middling among 23 countries on the overall flourishing scale, ranked second and third place on the (mental resources) dimensions of self-esteem and emotional stability, yet 17th and 18th place on positive relationships, engagement and meaning. Michaelson, Abdallah et al. (2009), using the same ESS data as Huppert and So (2013) (and which we, too, will use), also pointed out that many countries that score high on general markers of wellbeing show remarkable differences across wellbeing dimensions. For example, Hungary shows a "very low score for emotional (wellbeing) – absence of

negative feelings and a considerably above-average score for trust and belonging." Sánchez-Sellero, García-Carro and Sánchez-Sellero (2021), using the 2016 European Quality of Life Survey (EQLS), identified five different dimensions of evaluative wellbeing – in their terminology 'components of subjective quality of life': (1) satisfaction with governance (i.e., trust in legal system, parliament and government and satisfaction with democracy and economy), (2) subjective quality of public services (i.e., health services, public transport, education and pension system), (3) satisfaction with the immediate environment (i.e., satisfaction with accommodation, local area and family life), (4) general satisfaction with life and happiness, and (5) satisfaction with socioeconomic situation (i.e., satisfaction with education and standard of living, no difficulties making ends meet) and found sizeable consistency of ratings across these dimensions of subjective quality of life, meaning countries that scored overall high on general life satisfaction also scored high on the other dimensions of subjective quality of life.[16]

Regarding the correlates of different dimensions of subjective wellbeing, Ruggeri, Garcia-Garzon et al. (2020) reported lower psychological wellbeing scores for women compared to men, albeit these differences are only significant for the overall sample and four out of 27 countries (the Netherlands, Belgium, Cyprus, and Portugal). They also reported significantly higher scores for younger age groups compared to older age groups, as well as for those with higher education and employed respondents compared to unemployed respondents. Martela, Lehmus-Sun et al. (2023), using data from 27 countries participating in the ESS Round 6, examined how different dimensions of personal wellbeing significantly predict happiness, life satisfaction, and depressive symptoms. Specifically, the authors demonstrate that satisfaction of basic psychological needs, as well as its subdomains of autonomy, competence, and relatedness, are strong predictors of life satisfaction, happiness, and depression. The associations are less pronounced with several socioeconomic and demographic factors, indicating the independent effects of these psychological measures of wellbeing. Consistent with past research, they also find country-specific differences in the associations. Some countries exhibit stronger associations with happiness, others with life satisfaction or depressive symptoms, although the authors do not identify a clear pattern in these associations (Martela, Lehmus-Sun et al. 2023).

An increasing amount of research has investigated the effects of mindfulness-based practices, such as meditation and yoga, on subjective wellbeing. These studies indicate that such practices can positively influence mood, reduce stress levels, and enhance overall wellbeing (Brown and Ryan 2003). Furthermore, cognitive-behavioural therapies, including cognitive-behavioural therapy, have proven effective in fostering wellbeing, particularly among individuals experiencing depression and anxiety (Cuijpers, Berking et al. 2013). From the perspective of policymaking, a focus on the basic psychological need satisfaction and mental resources dimensions of subjective wellbeing, therefore, seems promising in the pursuit of achieving greater happiness for the greatest number of people (a commonly set goal for policymaking and individuals).

To our knowledge, no study has investigated the differences in subjective wellbeing across multiple dimensions of subjective wellbeing along the rural-urban continuum. The only exception – if we consider different dimensions of evaluative wellbeing to be different dimensions of subjective wellbeing – is Sánchez-Sellero, García-Carro and Sánchez-Sellero (2021), who used Eurostat's trichotomous degree of urbanisation (degurba) indicator, which differentiates between cities (densely populated areas, at least 50% of the population lives in urban centres), suburban cities (areas of intermediate density), and rural areas (sparsely populated areas, more than 50% of the population lives in rural areas). The study finds no significant differences in the overall measure of subjective quality of life, nor in the satisfactions most linked to the personal and socio-economic environment. By contrast, there are significant differences in those satisfactions related to public services and the government across different levels of urbanisation.

As past studies have noted, the underlying reasons for the differences in SWB between rural and urban areas are not yet well understood (Weckroth and Kemppainen 2021). One key factor limiting our understanding of rural-urban differences might be the one-sided focus on the evaluative dimensions of SWB. Studies using multidimensional

16 There are some countries for which the rank across the different dimensions varies by up to three positions only (UK, Bulgaria, Finland and Latvia), while two countries occupy positions at different poles of the league tables in some dimensions: Cyprus ranks in the bottom third place concerning quality of services but in a top 10 position (20th) regarding the immediate environment while Belgium ranks sixth concerning environment but 21st concerning quality of services. Fourteen countries have a difference of seven or less in rank positions across dimensions of subjective quality of life.

measures of SWB have shown the immense usefulness in comparing SWB profiles across countries (Michaelson, Abdallah et al. 2009, Huppert and So 2013, European Social Survey 2015, Ruggeri, Garcia-Garzon et al. 2020, Sánchez-Sellero, García-Carro and Sánchez-Sellero 2021, Martela, Lehmus-Sun et al. 2023). Moreover, the multidisciplinary approach to SWB has refocused the social dimension as a dimension of human wellbeing (Martela, Delle-Fave et al. 2023). For instance, research into the social determinants of health has highlighted that negative social experiences, including generalised social distrust and anxiety, as well as experiences of discrimination, can impact health and wellbeing through stress responses and other mechanisms (Braveman, Egerter and Mockenhaupt 2011). Aspects of social wellbeing, such as social cohesion, trust, respect, discrimination, safety, and loneliness, can impact overall SWB (Martela, Delle-Fave et al. 2023). Especially, loneliness is currently experiencing a renaissance of interest. While already central to several analyses of modern and urban life in Western countries (Putnam 1995), current research underscores the health risks associated with loneliness, including premature death. Consequently, several countries have reacted by appointing special ministers for loneliness (Wurm, Ehrlich et al. 2023), and development approaches which are sensitive to place attachment and belonging have been recommended for left-behind places (MacKinnon, Kempton et al. 2021).

In summary, while research into SWB is still heavily dominated by a focus on the evaluative dimension of SWB, the outlined research on the role of social ties for wellbeing and current concerns about the role of loneliness and, especially, the proposed close connection of urban anonymity and lack of social connection might make this dimension highly relevant to assess differences in SWB across the rural-urban continuum.

3.2. Data and methods

We use data from Round 6 (2012/13) of the European Social Survey (ESS), an academically driven cross-national survey conducted biannually across Europe since 2002/3 (Schnaudt, Weinhardt et al. 2014). The aim of the ESS is to provide high-quality, harmonised data to monitor the attitudes, beliefs, wellbeing, and behaviour patterns of diverse populations in Europe. ESS data is available free of charge and can be downloaded from the study website, which also provides a comprehensive study documentation (https://ess.sikt.no). The study adopts a complex survey design (Kaminska and Lynn 2017). Sampling files containing information about primary sampling and stratification units, as well as weights for early rounds of the study, are deposited with the country-level study documentation. Additionally, all survey instruments are included in the respective countries' languages.

The questionnaire in each round of the ESS consists of a core and two in-depth (repeated) modules. Round 6 of the ESS (European Social Survey European Research Infrastructure (ESS ERIC) 2023), which was fielded in 29 countries in 2012/13, was chosen for this analysis because it contains the latest in-depth module on "Personal and social wellbeing" (Huppert, Marks et al. 2010) and allows us to measure different dimensions of subjective wellbeing simultaneously in a large representative sample of the population living in Europe (subject to accounting for the complex cross-national survey design). Overall, approximately 54,600 people aged 15 or older living in private households in participating countries participated in the personal interviews, which were conducted either face-to-face or by phone (Jeffrey, Abdallah and Quick 2015).

Operationalising dimensions of subjective wellbeing

We had shortlisted the ESS Round 6 questionnaire as a tool that we could share in different languages with local actors across rural areas in Europe to collect information on and monitor the subjective wellbeing of the rural population. The "Personal and social wellbeing" module within the questionnaire comprised a total of 42 items. It was complemented by questions, which are included in each round of the ESS (so-called core questions), such as the general life satisfaction and happiness questions. The Round 6 questionnaire is, therefore, quite cumbersome. Moreover, through our involvement in the ESS Round 12 questionnaire development team[17] we anticipated that the module being prepared for the ESS 2025/26 (Round 12) would include considerably fewer items (30 overall, of which 10 items would be new) than the Round 6 module. We bore this in mind when setting up our analyses. Specifically, after mapping the ESS Round 6 wellbeing items onto the conceptual framework presented by Martela, Delle-Fave

17 GRANULAR team member Gundi Knies of Thünen-Institute (Germany) is one of the scientific leads of the ESS Round 12 "Personal and social well-being" module proposal.

et al. (2023), we picked that subset of items that (we knew from the cognitive and quantitative testing of the Round 12 module[18]) would be repeated in the Round 12 module, or would be the most suitable substitutes for any Round 6 items that would be dropped. The alignment of survey questions and SWB dimensions, as well as the question wording, is listed in Table 3-1.

We compute the Mazziotta-Pareto Index (MPI, Mazziotta and Pareto 2012), a composite index[19] to measure multidimensional phenomena (here: dimensions of subjective wellbeing). We reverse-coded all negatively worded questions so that higher values represent higher wellbeing. Considering the matrix $Y = y_{ij}$ with *n* rows (statistical units, here: individuals living in EEA member states that participated in ESS Round 6) and *m* columns (individual subjective wellbeing items within an SWB dimension), we first calculate the normalized matrix $Z = z_{ij}$ as follows:

$$z_{ij} = 100 \pm \frac{(y_{ij} - M_{y_j})}{S_{y_j}} 10$$

where M_{y_j} and S_{y_j} are, respectively, the mean and standard deviation of the indicator j in the population[20] and the sign $\pm$ is the 'polarity' of the indicator j. The sign indicates the relation between the indicator $j$and the phenomenon to be measured. We use + seeing as all our indicators represent a dimension of a positive good (wellbeing). Denoting with M_{z_i} , S_{z_i} , and cv_{z_i} the mean, standard deviation, and coefficient of variation of the normalised values for the unit i, respectively, the composite index is given by

$$MPI_i^{\pm} = M_{z_i} \pm S_{z_i} * cv_{z_i}$$

where the sign depends on the kind of phenomenon to be measured. When the composite index is 'increasing' or 'positive', i.e., increasing values of the index correspond to positive variations of the phenomenon, it is appropriate to use . The final MPI makes it possible to make relative comparisons: Values above 100 indicate above-average subjective wellbeing for the unit i compared to other people living in Europe, and values below 100 indicate values below the average.

Operationalisation of rural. To contribute to the outlined debates on rural-urban differences in SWB, we use the ESS settlement type variable as our main independent variable. The ESS routinely asks participants to report "(w)hich (…) best describes the area where (they) live?". The response options range from the largest, and most urbanised, settlement type [1] "A big city" (dubbed here: cities), [2] "the suburbs or outskirts of big city" (dubbed here: suburbs), [3] "a town or small city" (dubbed here: towns), [4] "a country village" (dubbed here: villages), to the smallest (and least populated) settlement type [5] "farm or home in countryside" (dubbed here: countryside).

Other independent variables. We include basic socio-demographic and socio-economic characteristics linked to life satisfaction. These are age group (15-24, 25-54, 55-64, 65 or older), sex, citizenship in the country of residence, marital status (married, separated/divorced, widowed, never married), living with children in the household, health limitations (no, slight, severe), Highest level of education (lower secondary or less, upper secondary, advanced vocational or sub-degree, degree or higher), main economic activity status in the last fortnight (employed, education, unemployed, permanently sick or disabled, retired, housework, looking after children, others, other), and net household income (deciles).

18 Unfortunately, it is not possible to share the results of this experimental work outside the ESS development team.

19 Composite indicators are frequently used to combine a great deal of information in a simplified dashboard-style statistic, see Saisana and Tarantola (2002). Notwithstanding their usefulness, there is continued debate about the appropriateness of composite (or synthetic) indicators. The approach relies on a series of decisions regarding the aggregation and weighting of the constituent items in the index. Studies have shown that the method of index construction and weighting procedures can severely affect evaluations of outcomes, see Greco, Ishizaka et al. (2019).

20 Given that the individuals participating in the ESS are not a completely random subset of the population, we apply the population weights and compute standard errors adjusted for clustering and stratification.

Table 3-1: Mapping of the ESS Round 6 subjective wellbeing items onto the Round 12 subjective wellbeing framework

Dimension	Construct	Question wording	Variable name
Basic psychological needs satisfaction	Autonomy[1]	To what extent do you make time to do the things you really want to do?	tmdotwa
		I feel I am free to decide for myself how to live my life	dclvlf
	Competence	In my daily life I get very little chance to show how capable I am.	lchshcp
		Most days I feel a sense of accomplishment from what I do	accdng[2]
		There are lots of things I feel I am good at.	lotsgot[2]
	Relatedness[3]	How often socially meet with friends, relatives or colleagues	sclmeet
		Take part in social activities compared to others of same age	sclact
		How many people with whom you can discuss intimate and personal matters	inprdsc
		How close do you feel to the people in your local area?	flclpla
Mental resources[6]	Resilience[4]	How difficult or easy do you find it to deal with important problems that come up in your life?	deaimpp
		When things go wrong in my life, it generally takes me a long time to get back to normal.	wrbknrm
	Mindfulness[5]	On a typical day, how often do you take notice of and appreciate your surroundings?	tnapsur
	Optimism	I'm always optimistic about my future	optftr
	Prosociality[7]	To what extent do you provide help and support to people you are close to when they need it?	prhlppl
		In the past 12 months, how often did you get involved in work for voluntary or charitable organisations?	wkvlorg
Affective wellbeing	Positive affect	How much of the time during the past week were you happy?	wrhpp
		How much of the time during the past week did you have a lot of energy?	enrglot
		How much of the time during the past week did you enjoy life?	enjlf
		How much of the time during the past week did you feel calm and peaceful?	fltpcfl
	Negative affect	How much of the time during the past week did you feel sad?	fltsd
		How much of the time during the past week did you feel depressed?	fltdpr
		How much of the time during the past week was your sleep restless?	slprl
		How much of the time during the past week could you not get going?	cldgng
		How much of the time during the past week did you feel anxious?	fltanx
Evaluative wellbeing[8]	Life satisfaction	How satisfied with life as a whole	stflife
	Happiness	How happy are you	happy
	Meaning in life	I generally feel that what I do in my life is valuable and worthwhile.	dngval
	Purpose in life	To what extent do you feel that you have a sense of direction in your life?	sedirlf
Social wellbeing[9]	Local support	To what extent do you feel that people in your local area help one another?	pplahlp
	Social trust	Most people can be trusted or you can't be too careful	ppltrst
		Most people try to take advantage of you, or try to be fair	pplfair
		Most of the time people helpful or mostly looking out for themselves	pplhlp
	Reciprocity in social exchange	To what extent do you receive help and support from people you are close to when you need?	rehlppl
	Respect	To what extent do you feel that people treat you with respect?	trtrsp
	Discrimination	Member of a group discriminated against in this country	dscrgrp
	Safety	Feeling of safety of walking alone in local area after dark	aesfdrk
	Loneliness	How much of the time during the past week did you feel lonely?	fltlnl

Notes:

[1] To be replaced in R12 by: To what extent are you doing the things you really want and value in your life? (dgwtva)

[2] To be replaced in R12 by: To what extent are you able to achieve your goals? (achgoal)

[3] R12 core additions: How often do you chat to your neighbours, more than hello? (chatnb); How strongly do you feel you belong to your neighbourhood? (stblgnb); How close and connected do you feel to other people? (clcnppl).

[4] To be replaced in R12 by: In difficult periods, I can usually find something good that helps me change for the better. (dprfgd)

[5] Addition in R12: In difficult situations, how often are you able to take a pause without immediately reacting? (dstpwir)

[6] The R6 "mental resources" "Engagement" and "Self-esteem" will not be repeated in R12. New concept: Self-compassion: When I'm going through a very hard time, I give myself the care and kindness I need. (kndhtm)

[7] R12 will additionally measure compassion: When you hear about an acquaintance going through a difficult time, how much compassion do you usually feel for them? (acqcomp)

[8] R12 new concept: "Inner harmony": To what extent do you feel there is harmony in your life? (hrmlife).

[9] R12 new concept: "Social harmony": To what extent do you feel there is harmony among the people who live in [country]? (hrmcnt) and "General safety": To what extent do you feel safe and secure in your life nowadays? (flsfsec)

Sample restrictions. Given the project focus on wellbeing in European rural areas, we focus the analysis on participating countries from the European Economic Area (EEA). These are Belgium (BE), Bulgaria (BG), Cyprus (CY), Czechia (CZ), Germany (DE), Denmark (DK), Estonia (EE), Spain (ES), Finland (FI), France (FR), United Kingdom (GB)[21], Hungary (HU), Ireland (IE), Iceland (IS), Italy (IT), Lithuania (LT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Sweden (SE), Slovenia (SI), Slovakia (SK).[22] In addition to looking at these countries as a whole (dubbed here: EU overall), we will group countries according to the welfare state typology developed by Lauzadyte-Tutliene, Balezentis and Goculenko (2018)[23], see Table 3-2.

Table 3-2: Overview of countries and welfare state models

Eastern Europe	Central Europe	Mediterranean	Old European – not Nordic	Old European – Nordic
Bulgaria, Estonia, Lithuania	Czechia, Poland, Slovakia, Slovenia, Hungary, East Germany[1)]	Spain, Italy, Cyprus, Portugal	Belgium, United Kingdom, Ireland[2)], Netherlands, France, West Germany[1)]	Denmark, Norway, Finland, Sweden, Iceland[2)]

Notes:

[1)] We differentiate between East and West Germany, treating East Germany as "Central European" (based on its socialist history and geographical proximity to the other Central EU countries) and West Germany as "Old European". The settlement structures differ, such that we do, e.g., only observe seven respondents in East Germany who live in the countryside, while in West Germany, this figure amounts to ~7%. Moreover, life satisfaction is significantly lower in East Germany.

[2)] Ireland and Iceland were not included in the analysis that informed the construction of the typology (Lauzadyte-Tutliene, Balezentis and Goculenko, 2018). We added the countries to the "Old EU" group, based on the shared history and geographical proximity with Northern Ireland and Denmark, respectively.

Analyses are restricted to those cases that have no missing information on any variables used in the empirical analysis. Table 3-3 provides an overview of the key dependent and independent variables used in this study, along with descriptive statistics.

Our analysis proceeds as follows. To set the scene, we present some basic descriptions of the population living in Europe (specifically in rural settlements) and describe the patterns of subjective wellbeing. First, we focus on Europe as a whole, but we will then explore the usefulness of grouping countries by welfare state regime, before examining individual countries and comparing the wellbeing of the population in rural settlements to that in non-rural settlements, as well as the key correlates of subjective wellbeing. In more technical terms, we first present univariate and bivariate population statistics and then see if the associations hold when we account for additional heterogeneity in population characteristics using multivariate linear regression models. All analyses are conducted using the statistical data analysis software Stata (StataCorp 2021), and we use the `svy` suite of commands to consider the complex survey design of the ESS appropriately.

21 The United Kingdom was part of the EEA until 31st December 2019.

22 Put differently, we drop cases from the non-European countries Australia, Israel and Russia, as well as cases from Switzerland, Albania and Kosovo. This focus also addresses some analytical challenges: No sampling files have been supplied for Israel, and Russia includes so many cases that our results would be skewed towards the experiences of the Russian population. A survey implementation error means that we could not produce indicators for all well-being dimensions for Albania.

23 Esping-Andersen (2001)'s more prominent typology was not useful in our case, as the typology excludes the new Eastern and Central European welfare states that we observe in the ESS. We did, however, split off the Nordic states, identified by Esping-Anderson as one group, from the otherwise very large "Old EU" group identified by Lauzadyte-Tutliene, Balezentis and Goculenko (2018).

Table 3-3: Descriptive statistics of key variables used in the analysis (EU overall)

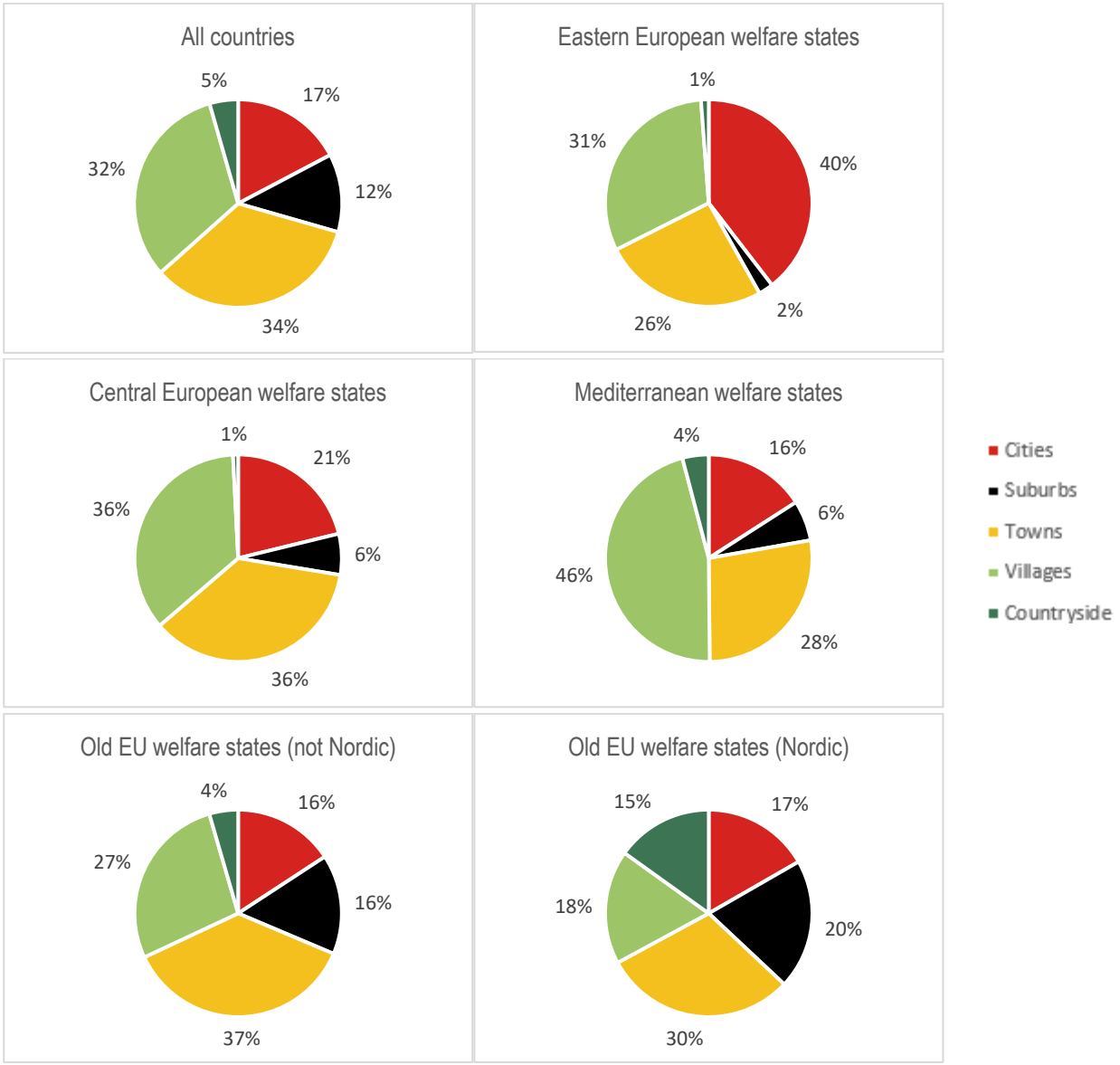
	Mean	SD	CV	Min	Max
Wellbeing measure (MPI)					
Life satisfaction	99.6	9.499	0.095	70.3	112.2
Affective wellbeing	99.5	6.327	0.064	73.9	109.7
Basic psychological needs satisfaction	99.0	4.980	0.050	75.3	115.2
Mental resources	99.2	5.538	0.056	70.2	114.2
Social wellbeing	99.6	5.417	0.054	74.4	112.3
Evaluative wellbeing	99.2	7.514	0.076	65.2	112.9
Settlement type					
Cities	0.205	0.404	1.970	0	1
Suburbs	0.119	0.324	2.720	0	1
Towns	0.319	0.466	1.460	0	1
Villages	0.288	0.453	1.573	0	1
Countryside	0.069	0.253	3.680	0	1
Welfare state group					
Eastern European	0.146	0.353	2.415	0	1
Central European	0.198	0.398	2.014	0	1
Mediterranean	0.111	0.315	2.823	0	1
Old European - not Nordic	0.321	0.467	1.455	0	1
Old European – Nordic	0.224	0.417	1.864	0	1
Number of observations	29913				

Notes: For descriptive statistics of all variables used in the analysis, see **Appendix 4** (A3-1).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

3.3. Results

In 2012/2013, over a third of the EU population lived in a rural settlement, either in a village (32%) or on a farm or house in the countryside (4%), see Figure 3-2. The most prevalent settlement type is living in small or mid-sized towns (34%). There is, however, considerable heterogeneity across European countries. In Mediterranean countries (here: Italy, Portugal, Spain, and Cyprus), the rural population accounts for 50%, while in Eastern European countries (here: Bulgaria, Estonia, and Lithuania), the proportion living in cities is relatively high, at 40% (across all of Europe, the figure is 17%). In Nordic countries (i.e., Denmark, Norway, Finland, Sweden, and Iceland), the proportion of people living on farms or in the countryside was three times the European average, at 15% compared to 4%. The Old European – not Nordic versus Nordic states have the same proportions of the population living in urban and rural settlements (67% and 33%, respectively). Within the urban category, however, a significantly larger population share in the non-Nordic states compared to the Nordic states lives in towns (37% compared to 30%), whereas a considerably larger share of the population in the Nordic states compared to the non-Nordic states lives in suburbs (20% compared to 16%). Within the rural category, a significantly larger population share in the non-Nordic states compared to the Nordic states lives in villages (28% compared to 18%), whereas a considerably larger share of the population in the Nordic states compared to the non-Nordic states lives in the countryside (15% compared to 5%).

Figure 3-2: Settlement structure across Europe and European welfare states (% of the population)



Notes: Population estimates for participating countries in the European Economic Area.
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

3.3.1. Settlement structure and subjective wellbeing across Europe

Table 3-4 reports the average subjective wellbeing scores for all countries and each welfare state group. By design, the average wellbeing scores in the EU amount to around 100 (i.e., the population average in the EU). Differentiation by welfare state shows that the Old European -not Nordic group, the most populous group in our analysis, most closely resembles the European average. The population in the Nordic countries show slightly above-average wellbeing scores across the board. By contrast, the population in the "Eastern European" countries scored significantly lower on life satisfaction than on any other subjective wellbeing dimension; the score is the lowest among all measured subjective wellbeing dimensions and welfare model groupings.

Table 3-4: Subjective wellbeing across Europe and European welfare states (Average Mazziotta-Pareto Indices, MPI)

	Life satisfaction			Affective wellbeing			Basic psychological needs satisfaction		
	Mean	95% CI		Mean	95% CI		Mean	95% CI	
All countries	100.0	99.8	100.2	99.4	99.3	99.6	99.3	99.2	99.4
Welfare state group									
Eastern European	92.0	91.3	92.6	97.3	97.0	97.6	98.2	97.8	98.5
Central European	98.7	98.3	99.1	99.0	98.8	99.2	99.2	98.9	99.5
Mediterranean	98.8	98.3	99.4	98.2	97.9	98.6	98.1	97.7	98.4
Old European - not Nordic	100.7	100.4	101.0	99.8	99.6	100.0	99.9	99.7	100.1
Old European – Nordic	104.3	104.2	104.5	100.7	100.6	100.9	101.3	101.1	101.4
	Mental resources			Social wellbeing			Evaluative wellbeing		
All countries	99.4	99.2	99.5	99.4	99.2	99.5	99.5	99.3	99.7
Welfare state group									
Eastern European	97.9	97.6	98.1	94.7	94.2	95.3	96.8	96.5	97.2
Central European	98.3	98.1	98.6	98.8	98.5	99.1	98.1	97.9	98.4
Mediterranean	98.7	98.4	98.9	98.5	98.1	99.0	98.8	98.5	99.1
Old European - not Nordic	99.6	99.5	99.8	99.9	99.7	100.2	99.7	99.5	99.9
Old European – Nordic	101.0	100.9	101.1	102.4	102.2	102.5	102.4	102.3	102.5

Notes: Population estimates for participating countries in the European Economic Area. See **Appendix 6** (A3-3) for further results.
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

3.3.2. Bivariate associations between settlement status and subjective wellbeing

Table 3-5 reports the average Mazziotta-Pareto Index (MPI) values across all countries by settlement type. It can be seen that the population living in the countryside reports the highest level of wellbeing in all dimensions of wellbeing – the rank position equals one across the board. There are no statistically significant differences in the average levels of affective wellbeing and basic psychological needs satisfaction by settlement type, as indicated here by the non-overlapping 95% confidence intervals. Average levels of Life satisfaction, Mental resources and social wellbeing are higher in the countryside than in cities, towns and villages; no statistically significant differences are observed in these wellbeing dimensions between countryside dwellers and suburbanites. Villagers also have significantly higher social wellbeing than those living in cities. No other statistically significant differences in average wellbeing by settlement type are observed.

To better compare the subjective wellbeing profiles across different settlement types and groups of countries, Figure 3-3 shows the wellbeing profiles for all countries and settlement types alongside those for the five different welfare state groups in so-called spider plots. We kept the format of the plots constant so that we can easily see how the different wellbeing dimensions are distributed across the different settlement types and groups of countries, with the spider net spanning from the lowest MPI (observed in Eastern European villages, in the life satisfaction domain, 90.5) to the highest MPI (observed in old European – Nordic villages, in the life satisfaction domain, 105.1). The exact population estimates and 95% confidence intervals underlying these plots are reported in **Appendix 7** (A3-4).

Table 3-5: Average subjective wellbeing by settlement structure across Europe (mean MPI)

Settlement type	Life satisfaction				Affective wellbeing				N
	Mean	95% CI		Rank	Mean	95% CI		Rank	
Cities	99.7	99.2	100.1	5	99.4	99.1	99.7	3	6130
Suburbs	101.0	100.4	101.5	2	99.8	99.4	100.1	2	3562
Towns	99.7	99.3	100.1	4	99.3	99.1	99.6	5	9554
Villages	100.0	99.6	100.3	3	99.4	99.1	99.6	4	8610
Countryside	101.4	100.5	102.3	1	100.4	99.7	101.0	1	2057
	Basic psychol. needs satisfaction				Mental Resources				N
	Mean	95% CI		Rank	Mean	95% CI		Rank	
Cities	99.2	98.9	99.4	4	99.1	98.8	99.4	5	6130
Suburbs	99.4	99.1	99.7	3	99.7	99.4	100.0	2	3562
Towns	99.0	98.8	99.2	5	99.3	99.1	99.6	3	9554
Villages	99.5	99.3	99.7	2	99.3	99.0	99.5	4	8610
Countryside	99.7	99.1	100.2	1	100.4	99.9	101.0	1	2057
	Social wellbeing				Evaluative wellbeing				N
	Mean	95% CI		Rank	Mean	95% CI		Rank	
Cities	98.7	98.4	99.0	5	99.2	98.9	99.6	5	6130
Suburbs	99.8	99.5	100.1	2	100.0	99.6	100.4	2	3562
Towns	99.1	98.9	99.3	4	99.3	99.0	99.5	4	9554
Villages	99.6	99.4	99.8	3	99.5	99.2	99.8	3	8610
Countryside	100.6	100.0	101.2	1	100.8	100.1	101.6	1	2057

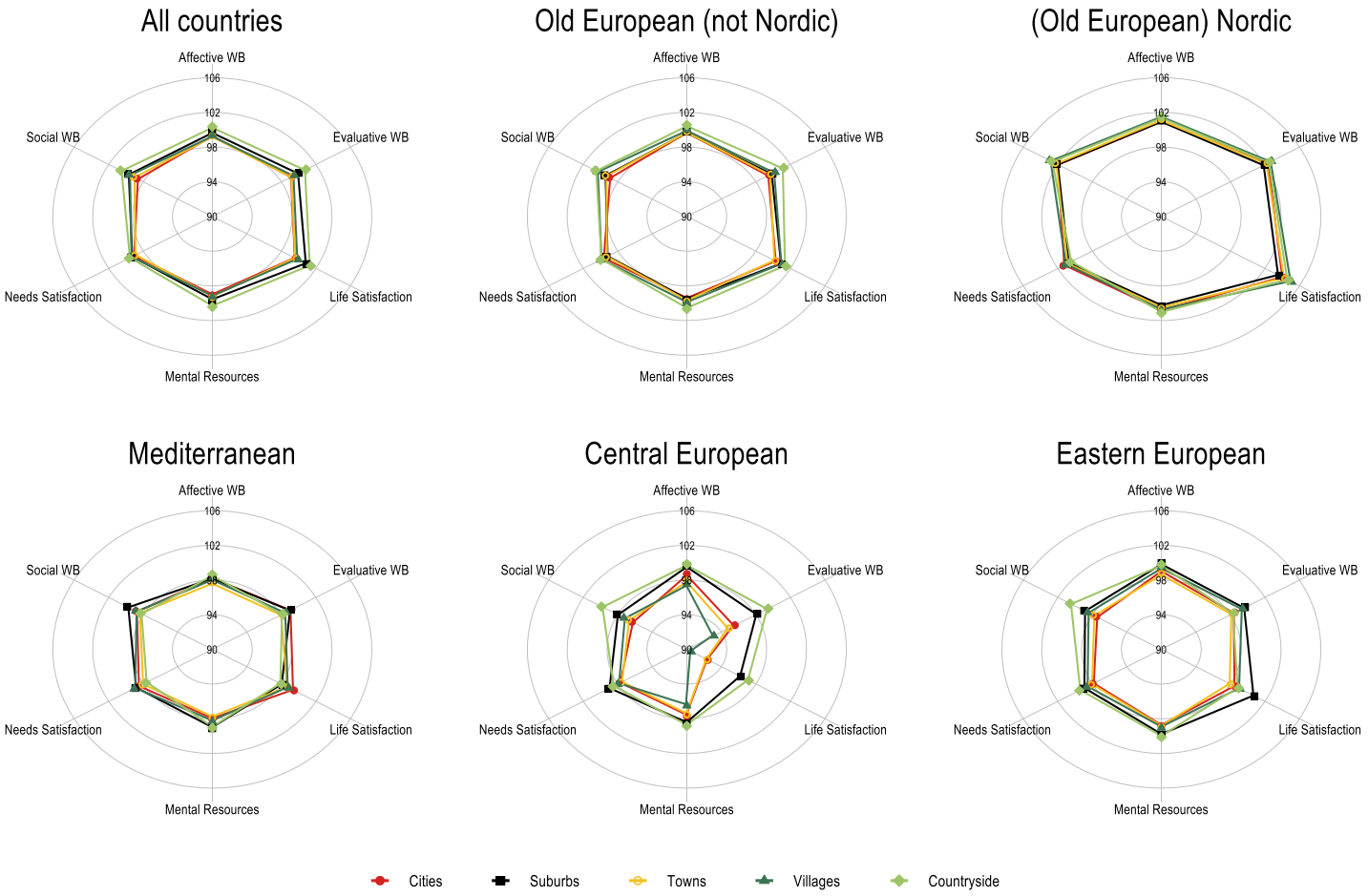
Notes: Unadjusted population estimates for ESS countries in the European Economic Area. See **Appendix 7** (A3-4) for further results.
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

While Figure 3-3 suggests considerable differences in the wellbeing profiles by settlement type and group of countries, relatively few of the differences are statistically significant (at the conventional 95% confidence level of statistical significance):

- In Eastern European countries, in villages, towns and cities, life satisfaction is lower than all other dimensions of wellbeing. Evaluative wellbeing, too, is lower in these settlements than affective wellbeing, basic psychological needs satisfaction, mental resources and social wellbeing;
- In Central European countries, life satisfaction in suburbs is higher than basic psychological needs satisfaction and social wellbeing;
- In Old European (not Nordic) countries, life satisfaction in the suburbs is higher than basic psychological needs satisfaction, mental resources and social wellbeing;
- In (Old European) Nordic countries, in all settlement types, life satisfaction is higher than all other dimensions of subjective wellbeing. Social wellbeing and evaluative wellbeing are also higher than affective wellbeing, basic psychological needs satisfaction, and mental resources in all settlement types.

While there appear to be clear patterns across countries and wellbeing dimensions, mainly relating to life satisfaction and evaluative wellbeing, which differ statistically significantly from the other wellbeing dimensions, we can also examine differences within wellbeing domains across settlement types. Again, relatively few of the differences are statistically significant (at the conventional 95% confidence level of statistical significance).

Figure 3-3: Spider plots of subjective wellbeing by settlement type and welfare state group



Notes: Unadjusted population estimates for ESS countries in the European Economic Area. See **Appendix 7** (A3-4) for tabular results.
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

Regarding life satisfaction, there are no statistically significant differences in life satisfaction by settlement type in the Mediterranean and Old European (not Nordic) countries. In the other groups of countries, too, there are few statistically significant differences in life satisfaction:

- In Eastern European countries, life satisfaction is higher in the countryside than in settlements other than cities. Villagers have lower life satisfaction than those in the suburbs;
- In Central European countries, life satisfaction in suburbs is higher than in any other settlement type;
- In Nordic countries, people who live in villages are more satisfied with life than those who live in suburbs or cities.

We do not observe any statistically significant differences in affective wellbeing by settlement type in the different welfare state groups, except:

- In Eastern European countries, those living in the countryside have significantly higher affective wellbeing than those living in villages.

We also do not observe any statistically significant differences in basic psychological needs satisfaction by settlement type in the different welfare state groups, except:

- In Old European (not Nordic) countries, those living in villages have higher basic psychological needs satisfaction than those living in towns;
- In Nordic countries, those living in cities have higher basic psychological needs satisfaction than those living in the countryside.

We do not observe any statistically significant differences in mental resources by settlement type in the different welfare state groups.

We observe several statistically significant differences in social wellbeing by settlement type and welfare state group of countries:

- In Eastern and Central European countries, people living in the countryside have higher social wellbeing than those living in villages, towns, and cities;
- In Old European (not Nordic) countries, people living in the countryside have higher social wellbeing than those living in cities or towns;
- In Nordic countries, people living in villages have higher social wellbeing than those living in towns, suburbs, or cities.

We also do not observe any statistically significant differences in evaluative wellbeing by settlement type in the different welfare state groups, except:

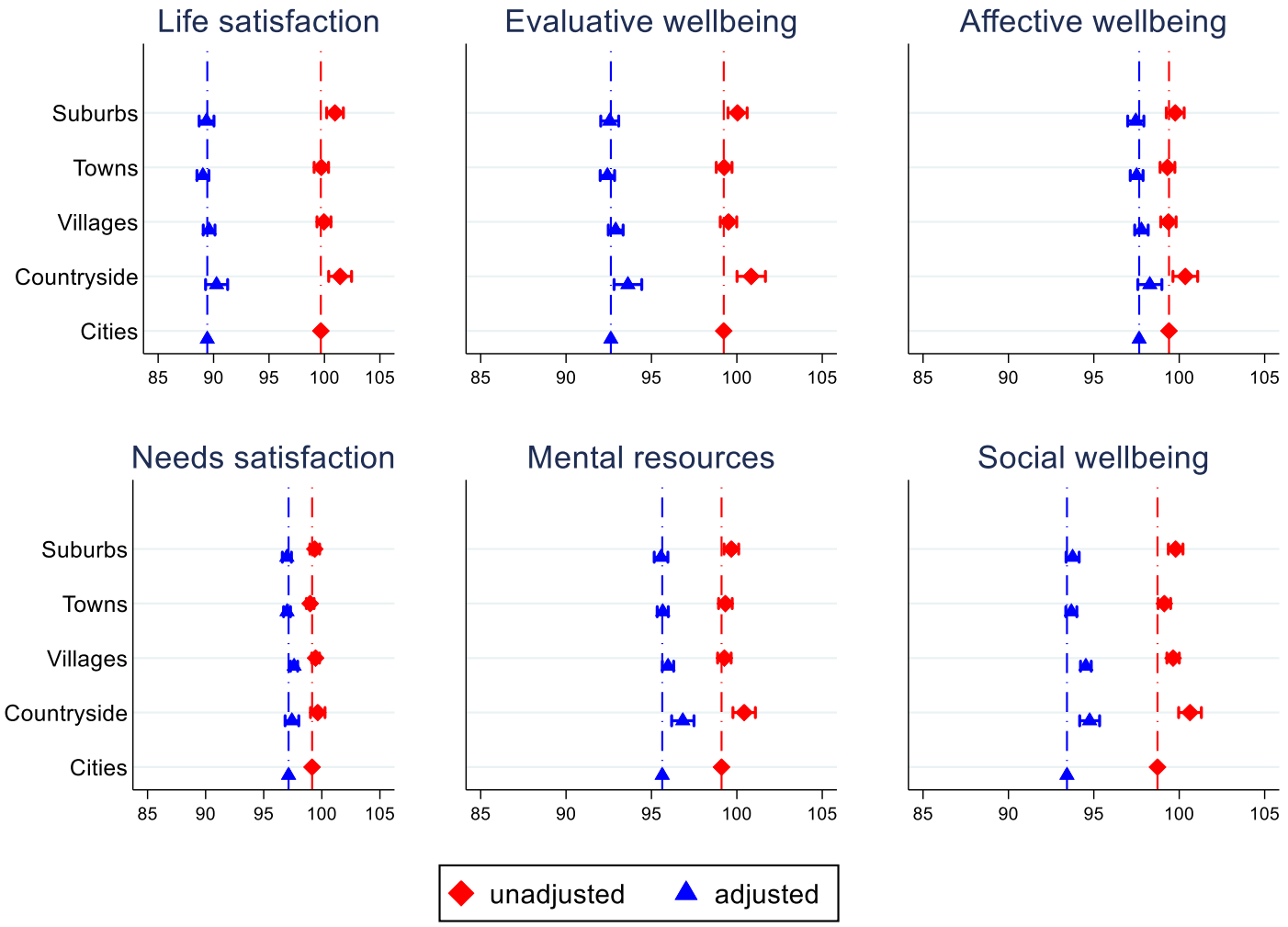
- In Eastern European countries, those living in the countryside have higher evaluative wellbeing than those living in cities, towns or villages.

3.3.3. Multivariate associations between settlement status and subjective wellbeing

Next, we examine whether individual and country-level differences in the populations may explain variations in average levels of subjective wellbeing by settlement. For this purpose, we estimate multivariate ordinary least squares regressions, first with only the settlement type as a control variable, followed by a fully adjusted model that considers the respondents' age, sex, socio-economic and demographic situation, and country of residence.

Figure 3-4 reports the regression coefficients for settlement type and the respective upper and lower-bound confidence intervals for the estimated effect on subjective wellbeing. For a complete set of results, see **Appendix 8** A3-5_LS to A3-5_EW). The reported coefficients indicate the difference in subjective wellbeing between an individual living in a suburb, town, village, or countryside and an individual living in the city (i.e., the reference category).

Figure 3-4: Multivariate predictions of subjective wellbeing on settlement type. Unadjusted and adjusted means.



Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement. See **Appendix 8** (A3-5_LS to A3-5_EW) for regression results in tabular format.

We find that statistically significant life satisfaction advantages of suburbanites ($\beta_{suburbs}$ = 1.28, 95% CI [0.53, 2.03]) and those living in the countryside ($\beta_{countryside}$ = 1.74, 95% CI [0.71, 2.77]) compared to city dwellers in the baseline model are accounted for by observed characteristics of the respective populations – i.e., the coefficients are not statistically significant in the model with a complete set of controls ($\beta_{suburbs}$ = -0.07, 95% CI [-0.74, 0.60]; $\beta_{countryside}$ = 0.84, 95% CI [-0.16, 1.83]). Similarly, a statistically significant affective wellbeing advantage of those living in the countryside ($\beta_{countryside}$ = 0.96, 95% CI [0.23, 1.68]) compared to those living in cities is statistically not significant in the full model ($\beta_{countryside}$ = 0.62, 95% CI [-0.08, 1.33]). While we do not observe any statistically significant wellbeing differences in basic psychological needs satisfaction, when we consider individual and country-level heterogeneity, we find that those living in villages report higher basic psychological needs satisfaction ($\beta_{villages}$ = 0.48, 95% CI [0.17, 0.78]) than those living in cities.

Concerning mental resources, we find that the wellbeing advantage of those living in the suburbs ($\beta_{suburbs}$ = 0.57, 95% CI [0.15, 1.00]) is explained by the observed characteristics of individuals (full model: $\beta_{suburbs}$ = -0.07, 95% CI [-0.47, 0.33]). In contrast, those living in villages ($\beta_{villages}$ = 0.34, 95% CI [0.01, 0.67]) and those living in the countryside ($\beta_{countryside}$ = 1.20, 95% CI [0.55, 1.86]) have significantly higher levels of mental resources than those living in cities (in the fully adjusted models). While we observe social wellbeing advantages for all settlement types compared to city dwellers in the baseline model, only the advantages for those living in villages ($\beta_{villages}$ = 1.11, 95% CI [0.79, 1.42]) and those living in the countryside ($\beta_{countryside}$ = 1.33, 95% CI [0.75, 1.91]) are robust in fully adjusted models.

Last but not least, we observe an evaluative wellbeing advantage for suburbanites ($\beta_{suburbs}$= 0.81, 95% CI [0.25, 1.37]) and those living in the countryside ($\beta_{countryside}$ = 1.61, 95% CI [0.78, 2.44]) compared to those living in cities in the baseline models but only the advantage for those living in the countryside is statistically significant in the fully adjusted model ($\beta_{suburbs}$ = -0.07, 95% CI [-0.59, 0.46]; $\beta_{countryside}$ = 1.00, 95% CI [0.19, 1.81]).

Differentiation by welfare state group supports the main EU-wide findings. Regarding life satisfaction, we find no differences in wellbeing by settlement type in Eastern European and Mediterranean countries. In Central European countries, life satisfaction advantages are observed for those living in suburbs ($\beta_{suburbs}$ = 1.69, 95% CI [0.41, 2.97]) and villages ($\beta_{villages}$ = 1.13, 95% CI [0.16, 2.09]) in the full model. Life satisfaction advantages for those living in the countryside in Old European (not Nordic) countries are accounted for by individual characteristics. In Nordic countries, the life satisfaction advantage of those living in villages is robust (baseline $\beta_{villages}$ = 1.03, 95% CI [0.44, 1.63]; full model $\beta_{villages}$ = 0.71, 95% CI [0.14, 1.29]).

In old European Nordic countries, those living in villages also have significantly higher affective wellbeing (baseline $\beta_{villages}$ = 0.50, 95% CI [0.02, 0.98]; full model $\beta_{villages}$ = 0.47, 95% CI [0.01, 0.93]). No other differences in affective wellbeing are statistically significant within the welfare state grouping of countries.

Regarding *Basic Psychological Needs Satisfaction*, we find that in Eastern European countries, all settlement types have significantly higher wellbeing than those living in cities (which is the most prominent settlement type in these countries). In Central European countries, villagers have higher *Basic Psychological Needs Satisfaction*. Lower levels of *Basic Psychological Needs Satisfaction* observed in Nordic countries in unadjusted models are not statistically significant in the fully adjusted models.

Regarding *Mental Resources*, we find that those living in villages in Eastern European welfare states are not significantly worse off compared to city dwellers when controlling for individual characteristics (baseline $\beta_{villages}$ = -1.24, 95% CI [-1.97, -0.50]; full model $\beta_{villages}$ = 0.64, 95% CI [-0.02, 1.30]). By contrast, those living in the countryside are significantly better off than those living in cities, but only when population heterogeneity is considered ($\beta_{countryside}$ = 1.46, 95% CI [0.21, 2.72]). The same is true for those living in Central European villages or the countryside – they have statistically significant wellbeing advantages compared to city dwellers, only when individual characteristics are controlled for. In Old European (not Nordic) countries, those living in the countryside have higher *Mental Resources* than those living in cities (full model $\beta_{countryside}$ = 1.09, 95% CI [0.29, 1.88]). For Nordic countries, we observe a wellbeing disadvantage for those living in suburbs (full model $\beta_{suburbs}$ = -0.63, 95% CI [-1.05, -0.21]).

In all but the Mediterranean welfare state group of countries, social wellbeing advantages are observed for those living in villages or the countryside compared to those living in cities. In Mediterranean countries, social wellbeing is higher among suburbanites than among city dwellers (full model βsuburbs = 1.15, 95% CI [0.13, 2.18]).

Evaluative wellbeing advantages are found for those living in Eastern European (full model $\beta_{countryside}$ = 2.68, 95% CI [0.84, 4.52]) and old European, not Nordic, countryside ($\beta_{countryside}$ = 1.46, 95% CI [0.49, 2.44]) compared to those living in cities, while the same is true for those living in Central European villages (full model $\beta_{villages}$ = 1.40, 95% CI

[0.71, 2.09]). No other differences between city dwellers and those living in other settlement types are statistically significant in the fully adjusted models.

3.3.4. Country-specific variation in associations

3.3.4.1. Settlement types and wellbeing

Overall, the results of the multivariate regressions show considerable heterogeneity in subjective wellbeing for the people living in different types of settlements. While the grouping of countries by welfare state group captures some cultural differences, we can still see a few statistically significant country effects (even in the models that group countries by welfare state). This suggests that this type of wellbeing analysis should ideally be undertaken also at a national level (and probably with a boost of cases in the least populated rural areas to draw more powerful conclusions).

As a first stab at exploring whether there are country-specific differences in the dimensions of subjective wellbeing, we present in which settlement type a country's average wellbeing score is the highest, separately for each dimension of subjective wellbeing (see Table 3-6). If there were a clear rural subjective wellbeing advantage—as suggested by the urban happiness paradox—we would expect the top half of the table to have no or significantly fewer entries than the bottom half of the table.

Table 3-6 shows that the average wellbeing of rural dwellers (i.e., those living in villages or the countryside) is highest in about 50% of the countries and highest among urban dwellers in the other ~50% of countries. The only notable exception is social wellbeing, the highest among urban dwellers in only five out of 24 countries. There is a substantial overlap of results for life satisfaction and the broader evaluative wellbeing in all but six countries: Cyprus, Denmark, and Iceland have the highest evaluative wellbeing among city dwellers but the highest life satisfaction among town (Cyprus) and village residents (Denmark and Iceland); Hungary switches from highest life satisfaction in suburbs to highest evaluative wellbeing in villages, while Finland switches from highest life satisfaction in the countryside to highest evaluative wellbeing in towns and West Germany from highest life satisfaction in villages to highest evaluative wellbeing in the countryside.

Table 3-6: Settlement structures with the highest average score in six dimensions of subjective wellbeing

Most well-off settlement	Life Satisfaction	Affective wellbeing	Basic psychol needs satisfaction	Mental resources	Social wellbeing	Evaluative wellbeing
Cities	BG, LT, CZ, ES, IT	BG, LT, D2, ES	LT, D2, DK, FI, SE, IS	BG, LT, PL, FI	IT	BG, LT, CZ, ES, IT, CY, DK, IS
Suburbs	EE, SK, SI, HU, D2	EE, CZ, SK, SI, HU, D1	EE, SK, PT	EE, CZ, SK, HU, ES, CY, PT	CZ, SK, ES, CY	EE, SK, SI, D2
Towns	CY	CY	SI, CY	SI		FI
Villages	PL, PT, D1, NO, DK, SE, IS	PL, IT, PT, DK, SE	BG, CZ, PL, HU, ES, IT, UK, NO	D2, IT, DK, IS	BG, LT, PL, SI, HU, D2, PT, D1, NO, DK	PL, HU, PT, NO, SE
Countryside	BE, FR, UK, IE, NL, FI	BE, FR, UK, IE, NL, NO, FI, IS	BE, FR, D1, IE, NL	BE, FR, D1, UK, IE, NL, NO, SE	EE, BE, FR, UK, IE, NL, FI, SE, IS	BE, FR, D1, UK, IE, NL

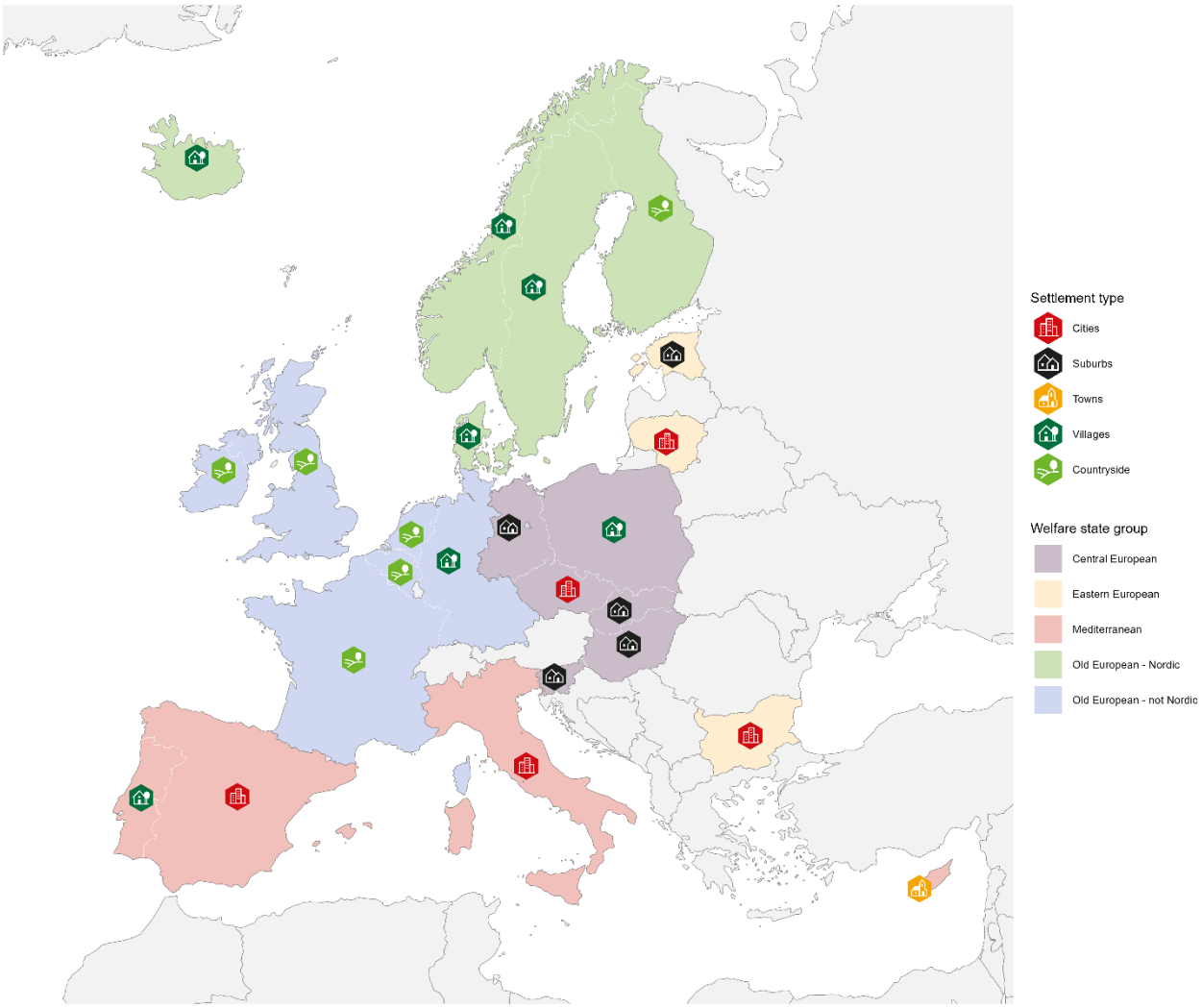
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement. For detailed results, see **Appendix 7** (A3-4).

Regarding the other dimensions of subjective wellbeing, we find considerable differences in which settlement type has the highest wellbeing in the 24 countries. For example, of the seven countries where life satisfaction is highest in villages, Poland, Portugal, Denmark and Sweden also have the highest affective wellbeing, only Poland and

Norway have the highest basic psychological needs satisfaction, only Denmark and Iceland have the highest mental resources and Poland, Portugal, West Germany, Norway and Denmark the highest social wellbeing in this settlement type. By contrast, of the six countries where life satisfaction was highest in the countryside, in four countries (Belgium, France, the Netherlands and Ireland), all other dimensions of wellbeing were highest in this settlement type. For the UK, affective wellbeing was highest in villages and for Finland, basic psychological needs satisfaction and mental resources were highest in cities.

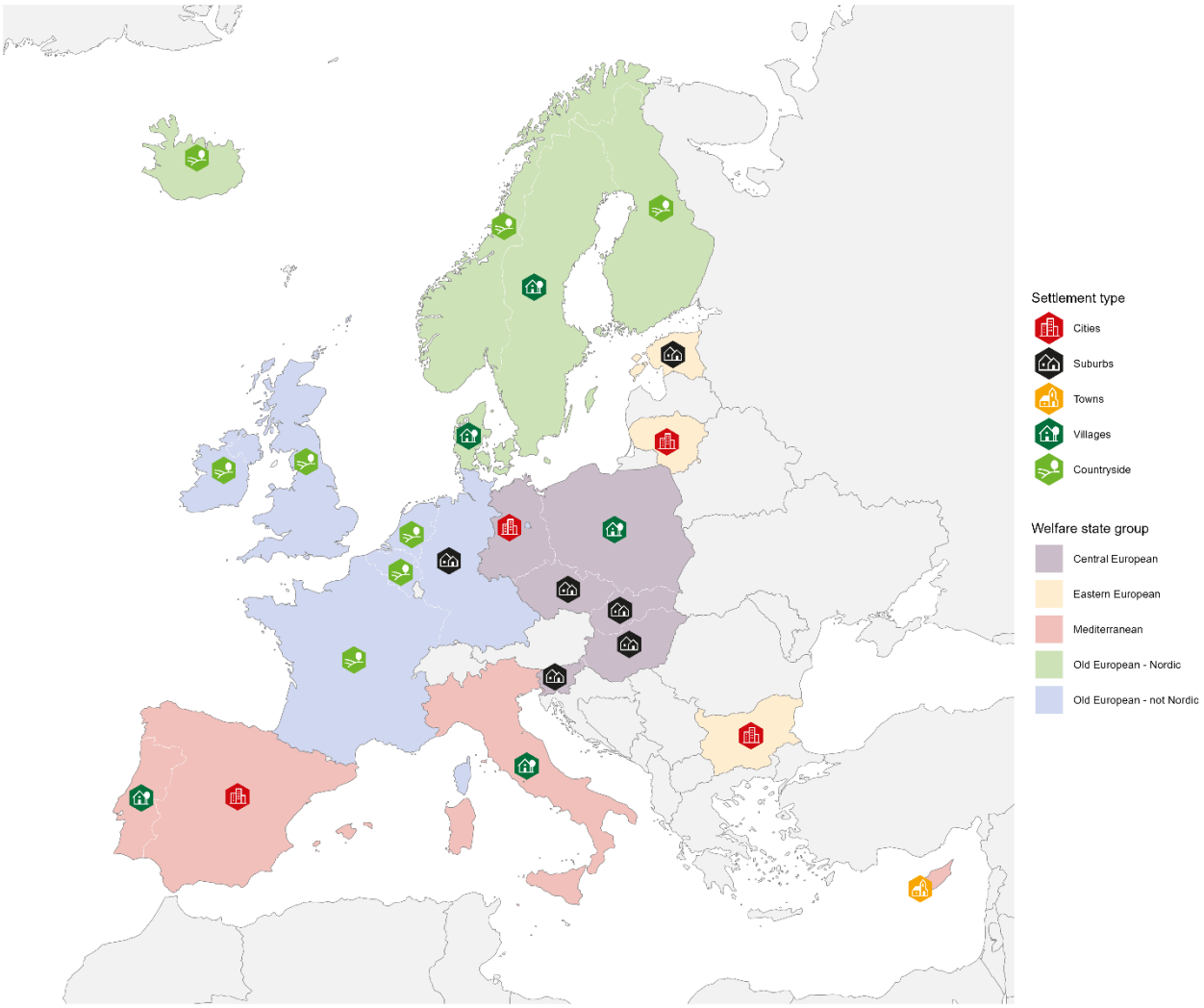
These associations between settlement type and wellbeing are also visualised in Figure 3-5 to Figure 3-10. Countries are coloured according to their membership in welfare state groups; the coloured icons show which settlement type has the highest wellbeing in the respective dimension. (See also Appendix 3-3a to 3-3f for detailed results, including confidence intervals and settlement type rankings.)

Figure 3-5: Settlement types with the highest life satisfaction in the EU



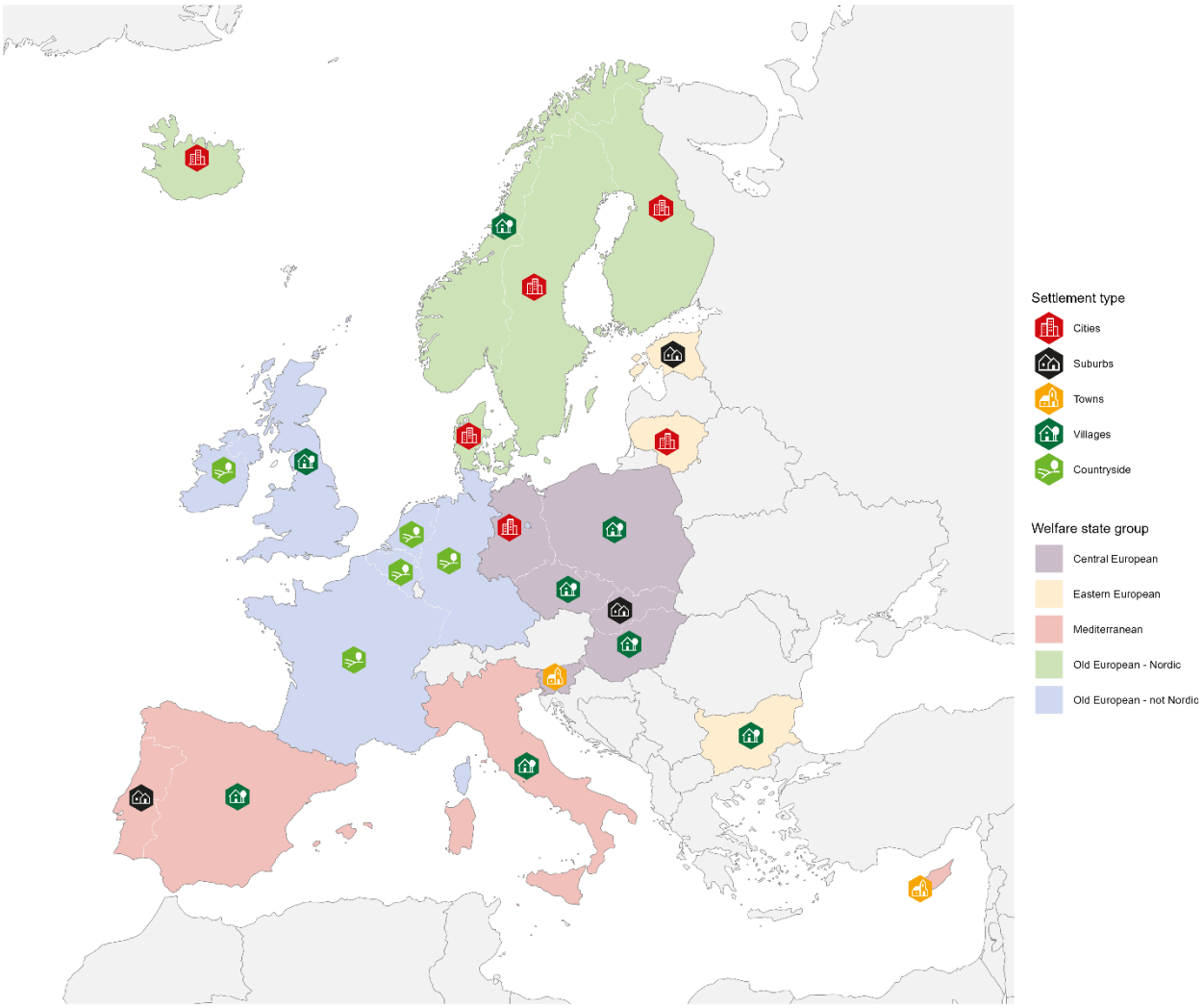
Notes: Icons produced by Ricardo Ferrand. Maps produced by Anna Augstein (Thünen-Institute).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

Figure 3-6: Settlement types with the highest affective wellbeing in the EU



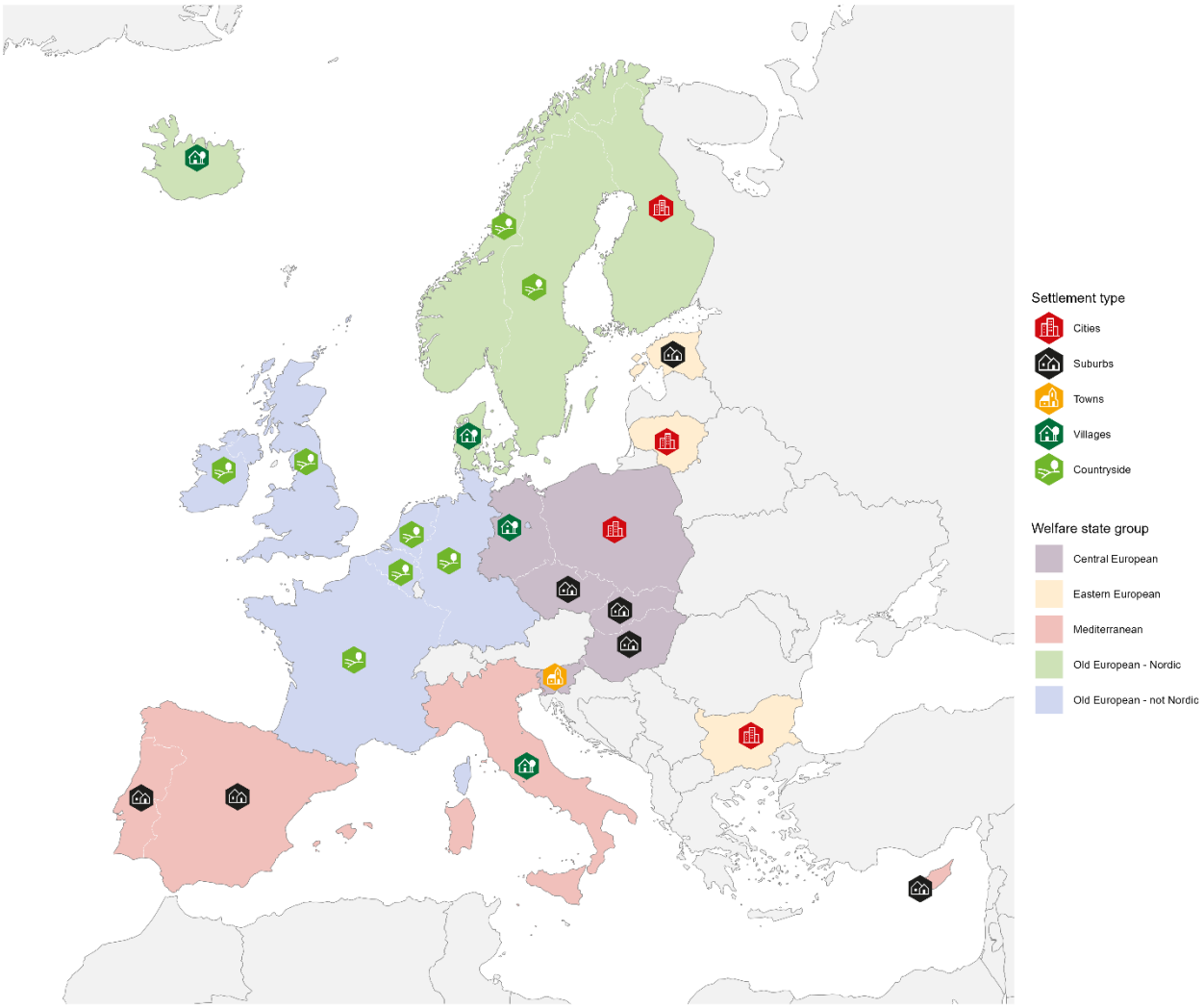
Notes: Icons produced by Ricardo Ferrand. Maps produced by Anna Augstein (Thünen-Institute).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

Figure 3-7: Settlement types with the highest basic psychological needs satisfaction in the EU



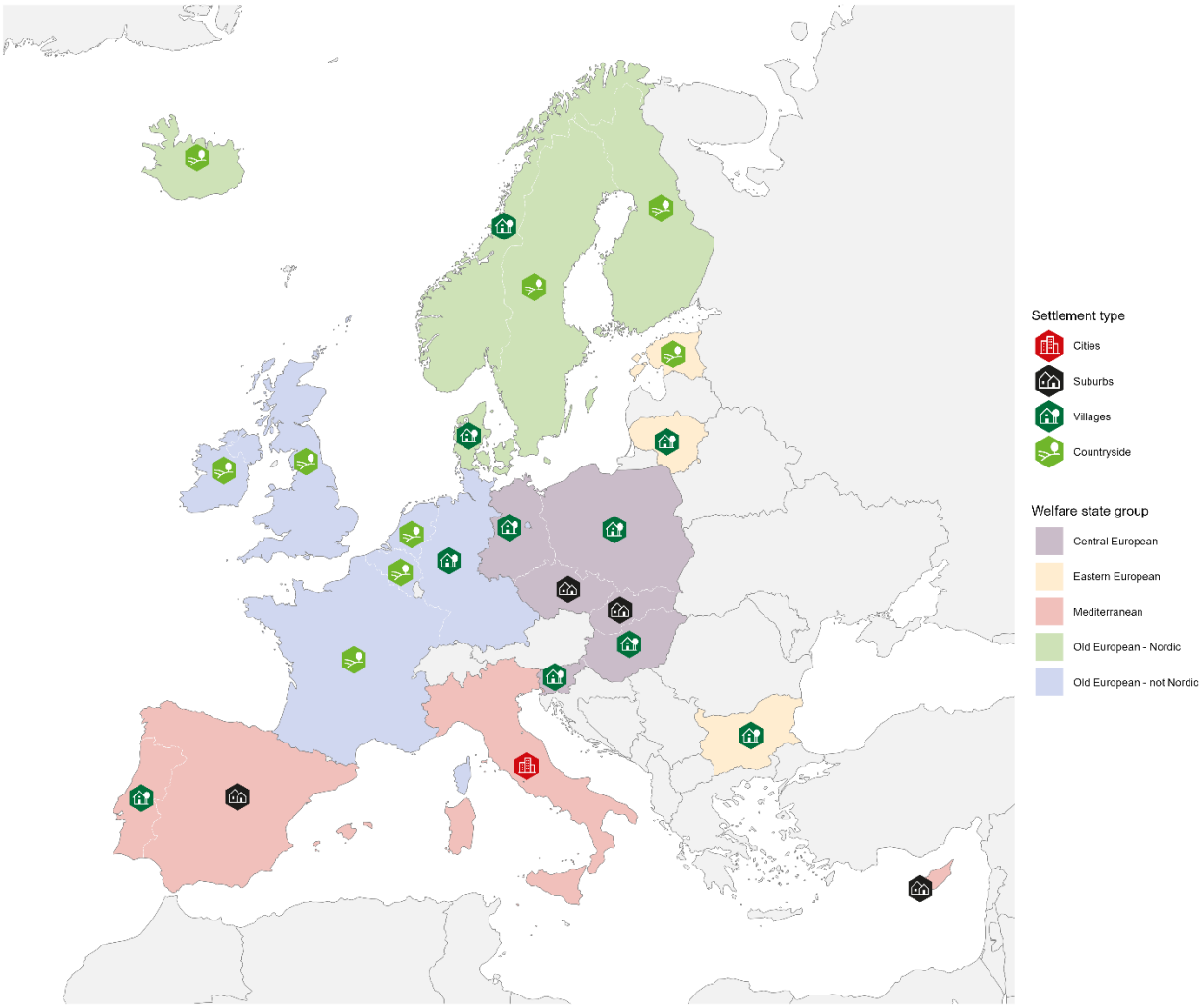
Notes: Icons produced by Ricardo Ferrand. Maps produced by Anna Augstein (Thünen-Institute).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

Figure 3-8: Settlement types with the highest mental resources in the EU



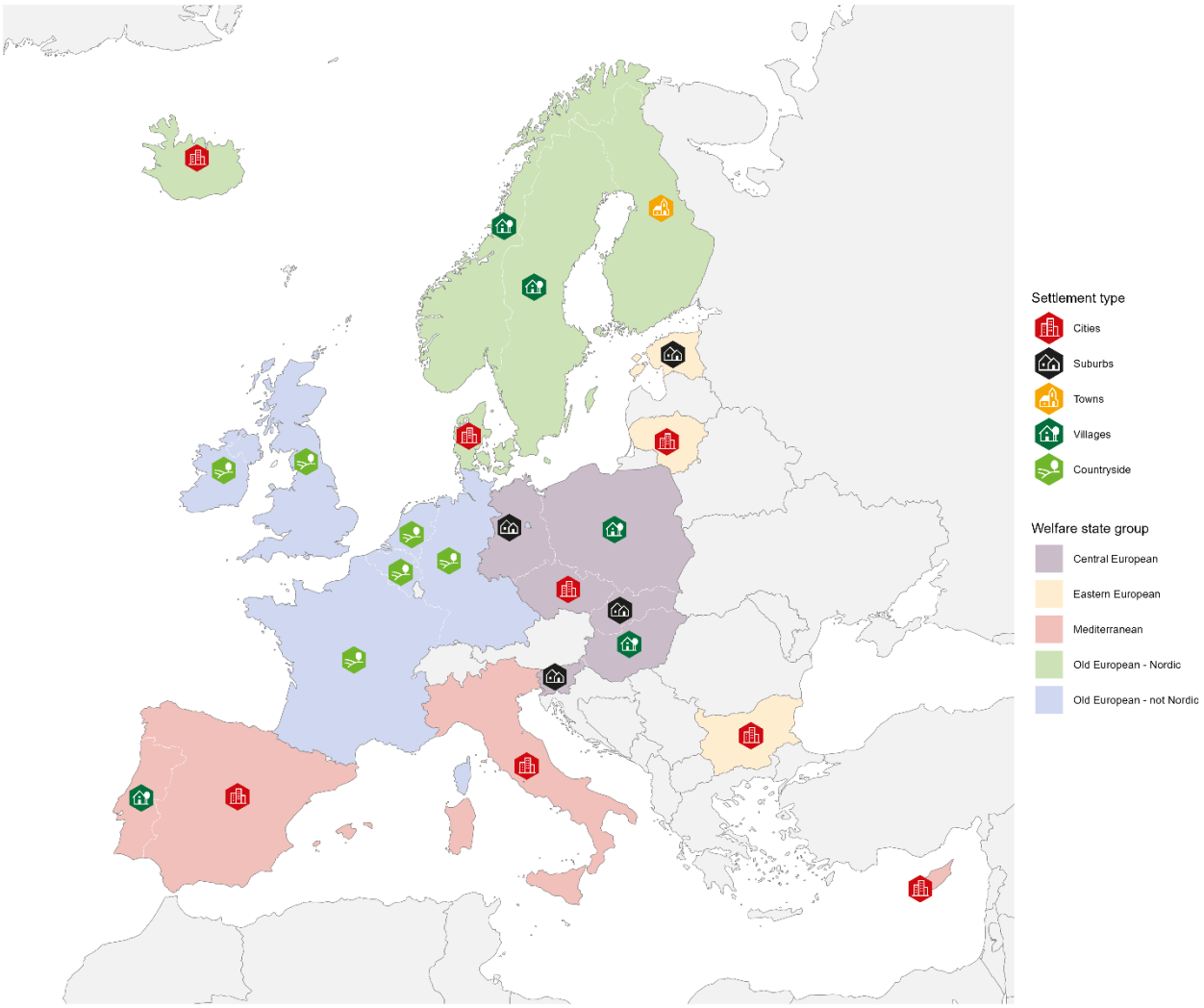
Notes: Icons produced by Ricardo Ferrand. Maps produced by Anna Augstein (Thünen-Institute).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

Figure 3-9: Settlement types with the highest social wellbeing in the EU



Notes: Icons produced by Ricardo Ferrand. Maps produced by Anna Augstein (Thünen-Institute).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

Figure 3-10: Settlement types with the highest evaluative wellbeing in the EU



Notes: Icons produced by Ricardo Ferrand. Maps produced by Anna Augstein (Thünen-Institute).
Source: ESS Round 6 (2012/13, ESS6e02_6) with sample file supplement.

3.3.4.2. Country-level wellbeing profiles

For countries with sufficient cases in rural settlements, it is also possible to create country profiles of rural wellbeing. In the following, we present such a profile for two countries participating in the GRANULAR project, which have Living Labs with a specific focus on “wellbeing”: the UK and the Netherlands. We can see that the proportions of the population living in rural areas, as well as their demographics, vary across the two countries. We additionally regressed demographic characteristics on each dimension of wellbeing to see which factors are contributing the most to higher and lower wellbeing in these countries (marked by the three largest positive and the three largest negative b-coefficients observed in the multivariate regressions. For complete results, see **Appendix 9** (A3-6_UK and A3-6_NL). For policymakers, these factors may be used to identify key groups of the population at risk of facing low wellbeing in rural areas.

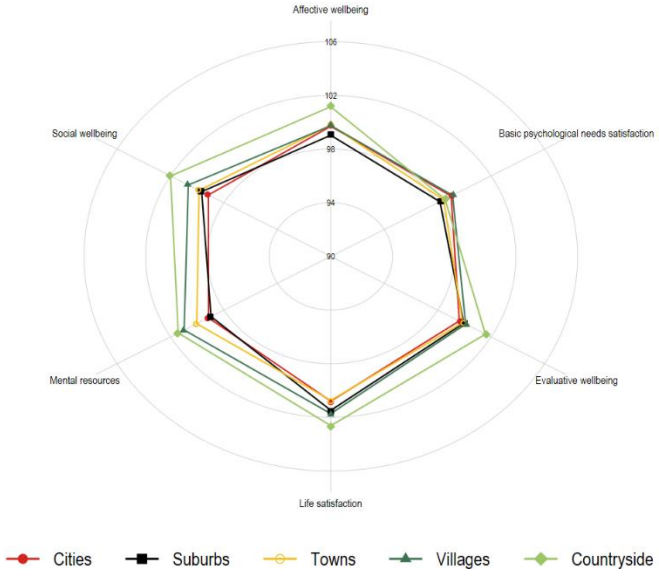
United Kingdom

About one in five people in the UK (19%) live in rural settlements, with villages being the second most frequent settlement type following small or mid-sized towns, which are home to 49% of the people in the UK.

Living in UK rural areas is associated with being separated or divorced (reference category: married) and with not being in education, not being permanently sick or disabled nor having a non-listed main economic activity status (such as being in the army or not working as in living off one's wealth; reference category: in employment).

Subjective wellbeing is considerably higher in the countryside and in villages than in urban settlements in all but the basic psychological needs satisfaction dimension.

Subjective wellbeing by settlement type



Being older, having good health, and a higher income stand out as the factors underpinning high rural wellbeing in the UK across all dimensions of subjective wellbeing. For basic psychological needs satisfaction, social wellbeing and evaluative wellbeing, having a degree or higher is beneficial. A key challenge to rural wellbeing across all dimensions of wellbeing is being unemployed, in education, looking after others, or being permanently sick or disabled. Those with children in the household experience reduced basic psychological needs satisfaction.

	Life satisfaction	***Affective wellbeing***	***Psychological needs satisfaction***	***Mental resources***	***Social wellbeing***	***Evaluative wellbeing***
+ + +	*Aged 65 or older (ref. 15-24)*	*No health limitations*	*No health limitations*	*Aged 55 to 64 (ref. 15-24)*	*Having a degree or higher*	*No health limitations*
+ +	*No health limitations*	*Household income: Top quintile (ref. Q1)*	*Highest level of education: degree or higher*	*Household income: Top quintile (ref. Q1)*	*Aged 65 or older (ref. 15-24)*	*Aged 65 or older (ref. 15-24)*
+	*Aged 55 to 64 (ref. 15-24)*	*Household income: 4th quintile (ref. Q1)*	*Household income: 3rd quintile (ref. Q1)*	*No health limitations*	*No health limitations*	*Having a degree or higher*
-	*Economic activity: permanently sick or disabled (ref. employed)*	*Economic activity: education (ref. employed)*	*Economic activity: unemployed (ref. employed)*	*Economic activity: unemployed (ref. employed)*	*Economic activity: unemployed (ref. employed)*	*Economic activity: other (ref. employed)*
- -	*Economic activity: unemployed (ref. employed)*	*Economic activity: unemployed (ref. employed)*	*Children in the household*	*Economic activity: other (ref. employed)*	*Economic activity: housework, looking after children, others (ref. employed)*	*Economic activity: unemployed (ref. employed)*
- - -	*Economic activity: other (ref. employed)*	*Economic activity: other (ref. employed)*	*Economic activity: housework, looking after children, others (ref. employed)*	*Economic activity: education (ref. employed)*	*Economic activity: other (ref. employed)*	*Economic activity: housework, looking after children, others (ref. employed)*

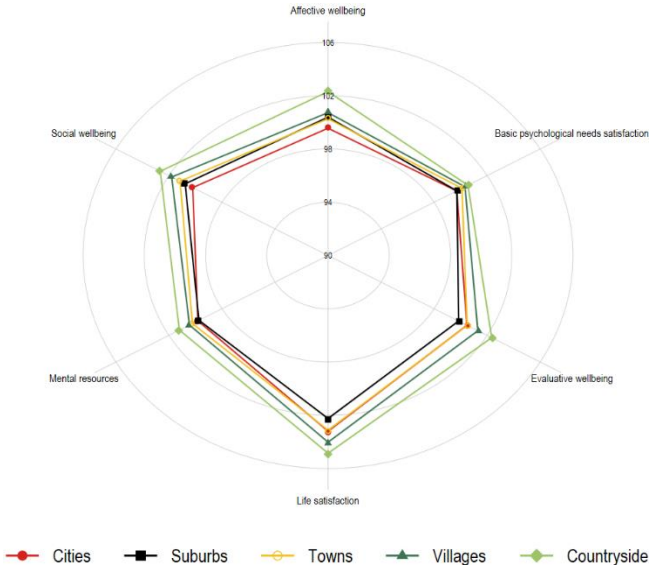
The Netherlands

More than one in three people in the Netherlands (38%) live in rural settlements; one in four people on a farm or house in the countryside. Only 13% live, more than double that in small or mid-sized towns, giving the Netherlands an overall rural and small-town flair.

Living in Dutch rural areas is associated with not being aged 25-54 (reference: aged 15-24), not being never married (reference category: married) and not having a degree.

Subjective wellbeing is considerably higher in the countryside and in villages than in urban settlements in all but the basic psychological needs satisfaction dimension. While life satisfaction is relatively high, affective wellbeing and basic psychological needs satisfaction is relatively low.

Subjective wellbeing by settlement type



Having a higher income stands out as the single most important factor underpinning higher rural wellbeing in the Netherlands. Affective wellbeing is positively impacted by good health. Key challenges to rural wellbeing differ by wellbeing dimension. The youngest (aged 15-24) have higher life satisfaction and evaluative wellbeing than the other age groups. Those looking after others or being permanently sick or disabled have lower affective wellbeing, basic psychological needs satisfaction and social wellbeing. Widowhood and being in education are negatively associated with basic psychological needs satisfaction and social wellbeing in rural settlements.

	Life satisfaction	*Affective wellbeing*	*Psychological needs satisfaction*	*Mental resources*	*Social wellbeing*	*Evaluative wellbeing*
+++	*Household income: Top quintile (ref. Q1)*	*Household income: Top quintile (ref. Q1)*	*Household income: Top quintile (ref. Q1)*	*Household income: Top quintile (ref. Q1)*	*Household income: Top quintile (ref. Q1)*	*Household income: Top quintile (ref. Q1)*
++	*Household income: 4th quintile (ref. Q1)*	*Household income: 4th quintile (ref. Q1)*	*Household income: 4th quintile (ref. Q1)*	*Household income: 4th quintile (ref. Q1)*	*Household income: 4th quintile (ref. Q1)*	*Household income: 4th quintile (ref. Q1)*
+	*Household income: 3rd quintile (ref. Q1)*	*No health limitations*	*Household income: 2nd quintile (ref. Q1)*	*Household income: 2nd quintile (ref. Q1)*	*Household income: 3rd quintile (ref. Q1)*	*Household income: 2nd quintile (ref. Q1)*
-	*Aged 55 to 64 (ref. 15-24)*	*Economic activity: housework, looking after children, others (ref. employed)*	*Economic activity: housework, looking after children, others (ref. employed)*	*Marital status: never married (ref. married)*	*Economic activity: permanently sick or disabled (ref. employed)*	*Aged 55 to 64 (ref. 15-24)*
--	*Aged 25 to 54 (ref. 15-24)*	*Marital status: widowed (ref. married)*	*Economic activity: permanently sick or disabled (ref. employed)*	*Aged 25 to 54 (ref. 15-24)*	*Marital status: widowed (ref. married)*	*Aged 65 or older (ref. 15-24)*
---	*Aged 65 or older (ref. 15-24)*	*Economic activity: permanently sick or disabled (ref. employed)*	*Economic activity: education (ref. employed)*	*Marital status: widowed (ref. married)*	*Economic activity: education (ref. employed)*	*Aged 25 to 54 (ref. 15-24)*

3.4. Discussion

A sizeable proportion of the EU population resides in rural settlements, with 32% living in villages and 4% on farms or in the countryside. The most common settlement type is small or mid-sized towns (34%), the middling category between cities and suburbs of cities and rural settlements. Rural living is particularly high in Mediterranean countries (50%) compared to Eastern European countries (40% urban population). In Nordic countries, the rural population living on farms or in the countryside is significantly higher than the EU average (15% vs. 4%).

When we investigate how the subjective wellbeing of people living in different types of settlements differs, typically, we are left with drawing on relatively simple bivariate associations. Doing this to explore whether there are specific wellbeing profiles for different types of settlements, we found considerable heterogeneity in the subjective wellbeing profiles across the different countries and settlement types. In the Nordic countries, in all settlements, life satisfaction is higher than all other dimensions of subjective wellbeing. Social wellbeing and evaluative wellbeing are also higher than affective wellbeing, basic psychological needs satisfaction, and mental resources in all settlement types. In Eastern European countries, in villages, towns and cities, life satisfaction is lower than all other dimensions of subjective wellbeing. Evaluative wellbeing, too, is lower in these settlements than affective wellbeing, basic psychological needs satisfaction, mental resources and social wellbeing. In Central European and old European - not Nordic countries, the subjective wellbeing profiles differ only for those living in suburbs: Life satisfaction is higher than basic psychological needs satisfaction and social wellbeing in Central European suburbs, while the same is true also for mental resources in old European - not Nordic countries. No statistically significant differences were found in the different dimensions of subjective wellbeing across the Mediterranean countries.

Bivariate associations may give a misleading impression, i.e., when unobserved characteristics that are linked to subjective wellbeing are also linked to where people live. To alleviate these concerns, we estimated a number of multivariate models that adjust for a comprehensive set of individual socio-economic and socio-demographic characteristics, as well as absorb country-level heterogeneity. We found that:

- Those living in suburbs or in the countryside show life satisfaction advantages over city dwellers, which are, however, explained by the characteristics of the population living in this settlement type.
- Countryside residents report higher affective wellbeing than city dwellers; this advantage is, however, explained by the characteristics of the population living in this settlement type.
- No significant differences were found overall in basic psychological needs satisfaction.
- Individual characteristics explain suburban residents' wellbeing advantage, while village and countryside residents have significantly higher mental resources than those in cities.
- Social wellbeing advantages exist for residents of all settlement types compared to city dwellers; the village and countryside advantage is robust to the inclusion of the characteristics of the population living in the respective settlement type.
- Both suburbanites and countryside residents report advantages over city dwellers in baseline models, but only the countryside advantage remains significant when controlling for observed population characteristics.

In summary, living in villages and the countryside is generally associated with higher wellbeing, particularly in terms of mental resources and social wellbeing. However, many advantages observed in the unadjusted results diminish when accounting for individual and country-level characteristics. In some cases, however, the wellbeing advantages only come to the fore when we consider that different types of people tend to live in different types of settlements. In line with past research, we find that these advantages are most pronounced on the social wellbeing dimension as suggested by theories of strong social ties in rural communities. It remains to be seen with more recent data whether this social wellbeing advantage persists after the pandemic, which has led to increased concerns over isolation and loneliness (e.g., O'Sullivan, Burns et al. 2021, Ernst, Niederer et al. 2022).

Moreover, mental resources appear to show a unique association with living on a farm or in the countryside. On the one hand, this could be related to scenic beauty and the mental wellbeing impact that these landscapes might offer.

In the GRANULAR project, in Task 4.5, we explore models to predict scenic beauty of rural areas across the EU and such model-derived indicators can be used in conjunction with individual panel data such as SOEP (Germany) and Understanding Society (UK) to explore the different pathways through which scenic beauty might impact

subjective wellbeing. On the other hand, farmers may have developed greater resilience and more optimism as a result of responding in different ways to challenges and overcoming difficulties in the past. Unfortunately, in the ESS data, we cannot differentiate between farmers and non-farmers living in the countryside. The sample size of those living in the countryside, too, is rather low in the ESS (some countries have fewer than 30 people in this settlement type). A designated study on rural wellbeing ought to consider collectin9/g additional information on whether the respondent is a farmer, and possibly boosting case numbers.

In line with the principles of the GRANULAR project, we then explored how the ESS survey module may be used to allow local actors to collect information on and monitor different dimensions of individual subjective wellbeing in rural areas. Currently, the number of cases living in rural settlements is rather low in some countries, limiting the statistical power to detect statistically significant associations. We demonstrated, however, that the wellbeing profiles are, in all likelihood, different in the different countries and settlement types, and so are the factors that are most strongly associated with higher and lower wellbeing. Local surveys might be useful to help local actors identify those most at risk of experiencing wellbeing losses and also to see whether there are any major diversions from common national patterns. With cross-sectional surveys, it will still be difficult, however, to analyse causal pathways to higher subjective wellbeing.

4. Is rural = rural? An empirical analysis of how findings on the rural life satisfaction advantage changes when we swap the definition of rural

4.1. Introduction

Our research is motivated by the developing body of research on the 'paradox' of rural areas in economically more developed countries often reporting a higher quality of life rather than cities, despite their lower access to resources (Sørensen 2021, Johansen, Fisker et al. 2023), which has reinforced the value of understanding measures of context in the analysis of subjective wellbeing. Our systematic review of European research has found that the majority of studies observe a rural wellbeing advantage over urban areas; however, this review also identifies critical caveats and uncertainties to this finding. The empirical evidence on which specific aspects of the local environment matter for subjective wellbeing primarily relates to urban spaces and draws on cross-sectional data, which do not address the main identification issues that permeate this type of research. Additionally, existing subjective wellbeing research often employs definitions of urban and rural areas that are self-defined by respondents, and/or lack detail, as they do not effectively distinguish between different types of rural areas. These observations represent the disagreement between formal and perception-based rural definitions, as well as the contribution of limited measures of rurality to uncertain conclusions (Bennett, Borders et al. 2019). Our motivation for analysing the effects on wellbeing of quantified, objective measures of rurality partly arises from established understanding about the sensitivity of wellbeing to (non-spatial) contexts (Ryff, Boylan and Kirsch 2021) and the need to find a balance between locally-grounded, context-rich understandings of wellbeing with the insights from more widely generalisable and 'large-n' approaches (Loveridge, Sallu et al. 2020, Ryff, Boylan and Kirsch 2021). Separately, despite increasingly sophisticated and multidimensional approaches to measuring and defining rural areas (Féret, Berchoux et al. 2020, Nelson, Nguyen et al. 2021, Veréb, Marques et al. 2024), it is recognised that "…social and cultural characteristics, environmental quality, and infrastructure quality" are under-represented in rural metrics (Nelson, Nguyen et al. 2021: 361). A lack of knowledge about the latter criteria is significant, as these themes are closely linked to wellbeing.

We contribute to an emerging body of research on the mediating and contextual drivers of rural-urban wellbeing differences (e.g., Sørensen 2021, Hoogerbrugge, Burger and Van Oort 2022, Biagi and Meleddu 2023, Lolle 2023, Jurčišinová, Želinský and Hudec 2025), which has arisen as wellbeing differences are a product of "a complex concurrency of environmental quality, social dynamics, and cultural preferences" alongside economic factors (Jurčišinová, Želinský and Hudec 2025: 25). Similarly, Prati (2024) has argued that the extremely small (although significant) effect of settlement population on wellbeing means that the characteristics of moderating mechanisms - rather than the rural-urban differences themselves - should be the focus of future research. These mechanisms and measures of context more broadly reflect the critically important interactions between people and places: for example, Sørensen (2021) tested the effects of satisfaction with place of residence, social capital and access to greenspace as potential causes of the rural-urban differences; Jurčišinová, Želinský and Hudec (2025) considered the influences of 'positive' and 'negative' environmental characteristics as routes by which the urban or rural location influences wellbeing; and similar factors were analysed by Lolle (2023). Coldwell and Evans (2018) also emphasised that the level of urbanisation does not affect wellbeing differences, but rather visits to green spaces. In a similar vein, Biagi and Meleddu (2023: 819) concluded that "…it is not living in rural areas per se that guarantees a higher life satisfaction but actually living in in rural areas where labour, leisure, social relations and access to amenities are more elevated in terms of availability and quality compared to other areas", and access to transport (and therefore nearby places more broadly) is critical in rural wellbeing (Doebler 2025). Furthermore, the fact that a person lives in an urban or rural area says very little about their experience of life in this type of place (Johansen, Fisker et al. 2023) as some of the benefits of urban areas spill over into surrounding rural areas, and wealthier people are in general more able to avoid negative experiences (Burger, Morrison et al. 2020); furthermore, as the positive and negative externalities of urban areas change over time, so does the correlation between rurality and wellbeing (Lenzi and Perucca 2020). These perspectives reflect the "Debated conceptualisation (and) contradicting results" associated with rural wellbeing research (Veréb, Marques et al. 2024: 239), and indicate the value of consistent measurements of the realities of local context and detailed rural diversity, alongside survey-based data on individual wellbeing. Finally, recent literature on the experiences of left-behind places has recognised the importance of the neighbourhood and local scale - "the geographical scale at which people experience their daily life" – and multi-scalar approaches to understanding wellbeing (Houlden, Robinson et al. 2024: 17), with the acknowledgement that places can be 'left behind' in many domains, including a lack of social capital, low environmental quality and poor infrastructure, in addition to being economically disadvantaged (Pike, Béal et al. 2023: 6). The consideration of the

neighbourhood scale is further supported by the importance of place attachment and social life within left-behind places (MacKinnon, Kempton et al. 2021) and the contributions to discontent of comparisons made with nearby areas (Pike, Béal et al. 2023) and nationally (McKay 2019), and the value of nested, multi-scale approaches to understanding wellbeing in left-behind places has been emphasised (Houlden, Robinson et al. 2024).

Therefore, we have identified that existing measures of rurality and neighbourhood environments are often unsuitable for understanding the drivers of rural-urban differences in wellbeing, as they lack granularity, detail and consistency of measurement. However, local and neighbourhood contexts appear to be under-utilised in wellbeing analyses, which often include partial variable selections and inadequately measured indicators, with the use of self-reported data on pollution and environmental quality being an example of the latter (Huebner, Oreszczyn et al. 2022). Knies and Melo (2019) have also argued that small area-level data on neighbourhoods have been used less often than expected in longitudinal research, and that some consistently measured economic indicators were unavailable at the local scale; the authors cited the example of the Index of Multiple Deprivation (IMD) as not consistently measured in composition, or for consistent spatial units, across different versions. IMDs within the UK have also been criticised for their poor identification of rural deprivation (Burke and Jones 2019, Clelland 2021). Some recent studies utilising Understanding Society (UKHLS) data have used IMD data for England only (Bonomi Bezzo, Silva and van Ham 2021, Houlden, Robinson et al. 2024, Doebler 2025), potentially reflecting the inconsistent structures of the IMD measures across countries in the UK. Our objective is to use a comprehensive set of geographic and socio-economic variables, representing quantitative measurements of the 'realities' of local context and diversity, to identify the environmental and place-based characteristics of rural areas that are most influential on life satisfaction, and which contribute to rural-urban differences in life satisfaction.

4.1.1. Hypotheses

The nature of the relationship between life satisfaction and living in a rural environment, however defined, and whether and how specific aspects of the physical and social environment affect life satisfaction, is not a priori known. Theories of life satisfaction and place suggest that rural living may be conducive to higher levels of wellbeing, owing to factors such as greater access to green space, lower exposure to pollution, stronger community ties, and a slower pace of life that facilitates social connectedness and psychological restoration. However, rural areas also pose potential disadvantages, including more limited access to services, reduced employment opportunities, and fewer cultural amenities, which may offset or diminish these possible benefits. The interplay of these competing mechanisms indicates that any rural advantage in life satisfaction is not inherent but contingent, shaped by both environmental characteristics and the resources available to individuals.

We formulate the following general hypotheses (all areas, controlling for rural–urban differences):

ACORN 2015 related:

- **H1:** Residents in "Farms and Cottages" areas report higher life satisfaction than those in most other ACORN categories, due to greater environmental quality and social cohesion.
- **H2:** Affluent suburban categories (e.g., "Affluent Achievers") may report life satisfaction levels similar to or higher than "Farms and Cottages", reflecting economic security and service access.
- **H3:** Deprived urban categories (e.g., "Urban Adversity") are expected to report significantly lower life satisfaction than "Farms and Cottages."

OAC 2011 related:

- **H4**: Residents in "Agricultural Communities" report higher life satisfaction than those in most other OAC groups, reflecting strong community ties and environmental advantages.
- **H5**: Residents in "Urbanities" and "Cosmopolitans" are expected to report lower life satisfaction compared to "Agricultural Communities" due to higher exposure to deprivation and pollution.
- **H6**: Residents in "Suburbanites" may show similar or higher life satisfaction compared to "Agricultural Communities," given their socioeconomic advantages and good service access.

- **H7**: Residents in “Hard-Pressed Living” areas are expected to report the lowest life satisfaction relative to “Agricultural Communities.”

Other neighbourhood-related:

- **H8:** Higher area deprivation (Townsend score) is associated with lower life satisfaction.
- **H9:** Greater distances to health services are associated with lower life satisfaction.
- **H10:** Proximity to leisure facilities is associated with higher life satisfaction, while accessibility to unhealthy outlets (fast food outlets, pubs and gambling outlets) is associated with lower life satisfaction.
- **H11:** Higher levels of air pollution (NO_2, PM_{10}, SO_2) are associated with lower life satisfaction.
- **H12:** Proximity to blue space and passive green space is associated with higher life satisfaction.

For rural and urban areas specifically, we hypothesise:

- **H13:** In rural areas, deprivation, access to services and unhealthy outlets have weaker associations with life satisfaction than they do in urban areas, reflecting adaptation to lower accessibility and lower prevalence.
- **H14:** In both rural and urban areas, access to leisure facilities, green and blue space, and lower air pollution are positively associated with life satisfaction.

4.2. Data and methods

We combine data from multiple sources at various scales, including individuals, households, neighbourhoods, and local areas, see Table 4-1.

Table 4-1: Overview of data sources used in the analysis

Unit or scale	Data	Source
Individual/household	Understanding Society: Waves 1-14, 2009-2023 and Harmonised BHPS: Waves 1-18, 1991-2009 [SN 6614]	University of Essex, Institute for Social and Economic Research
Neighbourhood	Census 2011 Rural-Urban Indicators [SN 7248] Acorn 2015 and 2023 [SN 7453]	University of Essex, Institute for Social and Economic Research
Local area (for data linkage)	Census 2011 Lower Layer Super Output Areas [SN 7248]	University of Essex, Institute for Social and Economic Research
Local area LSOA11 (n = 41,729) 34,753 LSOAs (E+W) + 6,976 Data Zones (S)	Lower Layer Super Output Areas (2011) boundaries Data Zone (2011) boundaries GHS-SMOD R2023A - GHS settlement layers GHS-POP R2023A - GHS population grid multitemporal (1975-2030) Census tables (2001, 2011, 2021, 2022) Census LSOA/Data Zone boundaries (2001, 2011, 2021, 2022) ONS Postcode Directory (November 2024) Access to Health Assets and Hazards 2017, 2019, 2022	Office for National Statistics Scottish Government EC Joint Research Centre EC Joint Research Centre Office for National Statistics, National Records of Scotland Office for National Statistics, Scottish Government Office for National Statistics Consumer Data Research Centre

The core data, at the individual and household levels, are longitudinal data from the first 14 waves of Understanding Society (University of Essex, Institute for Social and Economic Research et al. 2024). The panel study, also known as the UK Household Longitudinal Study (UKHLS), started in 2009 with a nationally representative, stratified, clustered sample of around 30k households in the UK and was enhanced further in the second and sixth waves when the around 8k households-strong continuing sample of the British Household Panel Survey (BHPS) and a new

immigrant and ethnic minority boost (IEMB), respectively, were added. The annual face-to-face survey collects information about various aspects of people's lives, including education, employment, income and health. All members of the household aged 16 and above are eligible for the interview.

The UKHLS includes a wide range of indicators of subjective and objective wellbeing and has frequently been used to examine wellbeing gaps for different groups within the population, including in a neighbourhood effects context. For our study, we focused on life satisfaction ($_sclfsato), the most prominent marker of subjective wellbeing studied in research about rural-urban differences in subjective wellbeing. Life satisfaction is based on the respondent's reflective appraisal of how well life is going and has been going (Argyle 2001). In the UKHLS, the measure is the response to the question "How satisfied are you with life overall?" with responses ranging from 1 "completely dissatisfied" to 7 "completely satisfied".

To account for the role of other relevant factors impacting on one's wellbeing, we include basic socio-economic and demographic controls, namely: age, gender, ethnicity, whether the respondent was born in the UK, marital status, presence of children in the household, highest educational qualification, the current main economic activity status, and net equivalent household income.

To demark rural places, we use two distinct classifications: the Rural-Urban Classification (RUC 2011) and the Degree of Urbanisation (DEGURBA2). **RUC 2011** is defined at the geographical scale of Output Areas (OAs), which are the smallest census units in the UK, averaging approximately 309 residents. OAs are classified as urban if their population-weighted centre falls within a built-up area, as defined by Ordnance Survey, that has a population of 10k or more. All other OAs, located outside these built-up areas, are categorised as rural (Bibby 2017). Urban areas and rural areas are further distinguished into four, respectively, six settlement types. These settlement types are identified using dwelling-density profiles organised in 100 m × 100 m grids at multiple scales (up to 30 km) to assess both settlement form and its broader context (sparsity). OA could include both developed and undeveloped land, yet still be classified as urban if the settlement component is dominant and fulfils the criteria for built-up areas (Bibby 2017). It's important to note that there is some variation across the UK; therefore, for this analysis, we are using the 10k population threshold for rural-urban classification, which is commonly applied throughout Great Britain.

DEGURBA2 relies on a population grid to classify local units. Classification unfolds in two stages (Eurostat 2023).In the first stage, each 1 km² cell is categorised as one of six classes:

- [1] cities (urban centres): contiguous grid cells of 1 km² with density ≥ 1.5k inhabitants/km² and a cluster population of at least 50k)
- [2] towns (Dense and semi-dense urban clusters): clusters of contiguous grid cells with density ≥ 1.5k/km² (dense) or ≥ 300/km² (semi-dense), population between 5k and 50k. Semi-dense clusters are those located more than 2 km from dense clusters or urban centres
- [3] suburbs (Suburban-peripheral areas): remaining grid cells within an urban cluster—not classified as dense or semi-dense
- [4] villages (Rural clusters): contiguous cells with density ≥ 300/km² and cluster population between 500 and 5k
- [5] dispersed rural areas (Low-density rural areas): grid cells with density between 50 and 300 inhabitants/km²
- [6] mostly uninhabited areas (Very low-density rural areas): cells with density less than 50 inhabitants/km²

Why might the values for RUC and DEGURBA2 differ in a particular location?

The Degree of Urbanisation (DEGURBA) uses grid-based population density and connectivity for classification, capturing complex patterns of habitation. In contrast, the Output Area Classification (OAC) classification relies on the proximity of population-weighted centroids to built-up areas of at least 10k people. This can result in a home at the edge of a town being labelled urban in DEGURBA (due to dense, contiguous population grids) but rural in the OA system (if the OA centroid lies outside the urban boundary). These discrepancies reflect the different ways the two systems define boundaries and thresholds, illustrating that "rurality" is defined by both measurement frameworks and the physical or social characteristics of the place.

In this analysis, a DEGURBA2 classification was allocated to Lower Super Output Areas (LSOA) 2011 on a population-weighted basis, using LSOA boundaries and two gridded datasets published by the European Commission Joint Research Centre (Schiavina, Freire et al. 2023, Schiavina, Melchiorri and M. 2023) on the estimated population and DEGURBA2 classification of 1km² grid cells in 2020. For

each LSOA, the DEGURBA2 classification with the highest population was allocated to the whole LSOA. These data were linked to survey data using the household ID and LSOA look-up file provided by the UKHLS team (University of Essex and Institute for Social and Economic Research 2024).

> *LSOAs in Britain were first delineated for the 2001 population census: Units are based on spatial proximity, natural boundaries, as well as homogeneity of dwelling type and tenure, so that aggregations of Output Areas (OAs) to areas of around 600 households (~1.5k people) would refer to localities that local people conceive as neighbourhoods. Output Areas (OAs) are the lowest level of geographical area for census statistics and were first created following the 2001 Census. 2011 OAs have between 40 and 250 households and a usual resident population between 100 and 625 persons.*
> *LSOAs are "substantially smaller and more internally homogenous than the geographies that have been relied upon by many previous studies, enhancing our ability to uncover evidence of neighbourhood processes operating within local communities" (*Sutherland, Brunton-Smith and Jackson 2013: 1055-1056*).*

To explore how different aspects of the local environment influence life satisfaction, we use two distinct geodemographic classifications: The ONS's Output Area Classification (OAC 2011) (University of Essex and Institute for Social and Economic Research 2024) and the 2015 ACORN typology (University of Essex and Institute for Social and Economic Research 2024).

The **OAC 2011** is a geodemographic classification built from over 60 UK 2011 Census data at the OA level using k-means clustering applied hierarchically — first forming eight supergroups, then refining into 26 groups, and finally into 76 subgroups (Office for National Statistics 2015). It is designed to capture statistically distinct neighbourhood types based on demographic, socio-economic, housing, employment, and household composition metrics. We focus on supergroup 1 – Rural Residents, which includes several specific subgroups: Agricultural Communities, Established Farming Communities, Older Farming Communities, Rural Tenants, Rural White-Collar Workers, Ageing Rural Flat Tenants, and Ageing Rural Dwellers. In our data analysis, we use 'Agricultural Communities' as the reference category. We compare all other rural groups to these communities, which have active agricultural livelihoods, high employment in agriculture, forestry, or fishing, and typical rural living patterns, often involving family-run farms. Other groups, like Ageing Rural Dwellers or Rural Tenants, differ significantly in household makeup, housing arrangements, age, and jobs, offering a clear contrast to the agricultural baseline. For all other supergroups, we include a group dummy.

The **2015 ACORN** (A Classification of Residential Neighbourhoods) is a commercial geodemographic classification developed by CACI, which assigns each UK postcode to a hierarchical structure of six categories, subdivided into 18 groups and further into 62 detailed types. ACORN combines a wide range of sources—2011 Census data, administrative records, consumer and lifestyle datasets, housing and property information, and commercial databases—integrated at the postcode level using statistical matching methods (CACI 2017)[24]. The classification is designed to capture socio-economic, demographic, and lifestyle variations across UK neighbourhoods, reflecting differences in affluence, housing forms, household compositions, consumption patterns, and access to services. We focus on Group F – Countryside Communities, part of the "Comfortable Communities" category. This group includes "F21 Farms and Cottages," which serves as our reference point. It represents traditional rural households in scattered areas with older homes tied to farming or local businesses. These areas usually have long-term residents and a mix of older families. In contrast, the "Older couples and families in rural areas" group has more couples and children living in detached houses. This group relies less on agriculture and has stronger ties to nearby towns for commuting. "F23 Owner occupiers in small towns and villages" consists mainly of owner-occupied homes in small towns. These areas offer a range of job types, many not related to farming, and typically have settled households and better access to services. In our analysis, we set "F21 Farms and Cottages" as the reference category. We compare other types in the "Countryside Communities" group and five other ACORN groups to this rural baseline. Other ACORN groups, like Urban Adversity or Affluent Achievers, represent contrasting urban or suburban lifestyles

24 Later versions of the ACORN classification use machine learning and deep learning methodology.

with different socio-economic conditions, housing markets, and consumer behaviours. This provides clear comparisons with our rural reference type.

To absorb further unobserved heterogeneity in rural and urban neighbourhood contexts, we include the Townsend Area Deprivation Score and indicators from the index of Access to Healthy Assets and Hazards (AHAH). These are linked to UKHLS using the LSOA look-up file (University of Essex and Institute for Social and Economic Research 2024).

The **Townsend Score of Area Deprivation** (2001, 2011, 2021) is a composite measure of material deprivation which was developed in the UK in the late 1980s (Townsend, Phillimore and Beattie 1988) following earlier conceptualisation of the link between deprivation and resource availability (Townsend 1979). Material deprivation is "a direct measure of poverty derived from the lack of items and activities deemed to be necessary for a minimum standard of living" (McKnight, Bucelli et al. 2024). Townsend Scores have been calculated for LSOA units based on a relatively simple analysis involving four indicators, which are calculable from Census datasets: the proportions of residents who are unemployed, and three indicators based on percentages of households which are a) overcrowded, b) not owner-occupied, and c) without access to a car. Standardised values of these indicators (following log transformation of the values of unemployment and overcrowding) are summed to form the Townsend Score, with higher values representing greater deprivation (Yousaf and Bonsall 2017). In this analysis, we calculated Townsend Scores for 2011 LSOAs in Great Britain (England, Scotland, Wales) for 2001, 2011 and 2021 using Census data for these three years and data from the 2022 Scottish Census. Changes in the boundaries and numbers of LSOAs between Censuses present a considerable challenge in calculating comparable variables over time. In our analysis, we used the distribution of postcodes (as of 2024) as a proxy for the population distribution, to re-allocate Census data from 2001 and 2021-22 to the 2011 LSOAs on a proportional basis. By doing this, we enhance the consistency and comparability of deprivation measurement. The LSOA look-up file was used to link the Townsend Scores to individual responses in the UKHLS datasets. Scores for 2001 were used for responses in 2010 or earlier; 2011 scores were used from 2011 to 2020, and 2021 scores were used from that year onwards.

Calculations of the DEGURBA2 and Townsend Deprivation scores, described above, were carried out using R (R Core Team 2024) and the packages "sf" (Pebesma 2018, Pebesma and Bivand 2023), "dplyr" (Wickham, François et al. 2023), "terra" (Hijmans 2025), "exactextractr" (Baston 2023) and "mapview" (Appelhans, Detsch et al. 2023).

The **Access to Health Assets and Hazards (AHAH)** (2017, 2019, 2022) is a multi-dimensional index developed by the CDRC for Great Britain, measuring how 'healthy' neighbourhoods are. The AHAH index combines indicators under four different domains of accessibility:

- Retail environment (access to fast food outlets, pubs, off-licences, tobacconists, gambling outlets),
- Health services (access to GPs, hospitals, pharmacies, dentists, leisure services),
- Physical environment (Blue Space, Green Space - Passive, Green Space - active), and
- Air quality (Nitrogen Dioxide, Particulate Matter 10, Sulphur Dioxide).

We use the individual components of the index, not the composite index, seeing as we want to work out how these factors influence wellbeing differently in different types of rural and urban areas. Indicators for 2017 are used as proxies for the surveys conducted in 2009-2017, indicators for 2019 for the surveys conducted in 2018 and 2019, and indicators for 2022 for surveys conducted in 2020-2022. Due to changes in the availability of variables over time, our analysis does not include all variables in the full AHAH list given above; more specifically, access to tobacconists, off-licenses, hospitals, and active green space are not included in our analysis.

For the Reader's convenience, Table 4-2 provides an overview of the variables used in this analysis. Descriptive statistics of all variables used in the analysis are provided in Appendix 10 (A4-1).

Table 4-2: Overview of variables used in this analysis

Blocks of variables included in the regressions	
Rural-urban definition (R/U) RUC2011: Urban = greater or equal 10k population Rural = less than 10k population DEGURBA 2: Urban = Cities, Towns, Suburbs [1-3] Rural = Villages, Dispersed Rural Areas, Mostly uninhabited areas	**Area characteristics - Deprivation (D)** Townsend Deprivation Score
Individual and household characteristics (I) Age, Age^2, Sex, Born in UK, Ethnicity [reference: White British], Employment status [reference: employed], Real equivalent household income, Highest qualification [reference: degree or higher], Number of children in household, Marital status [reference: single], Housing tenure [reference: owner-occupied]	**(other) Area characteristics (A)** Access to the retail environment (three variables) Access to health services (four variables) Access to the physical environment (two variables) Air quality (three variables)
Geodemographic characteristics (G) Output Area Classification 2011 [reference: Agricultural Communities] ACORN 2015 [reference: Farms and Cottages]	

4.2.1. Empirical strategy

We adopt a standard micro-economic life satisfaction model that assumes that exogenous individual and neighbourhood characteristics have a direct impact on life satisfaction:

$$Y_{it} = \propto + \beta' X_{it} + \gamma' N_{jit} + \varepsilon_{it} \qquad (1)$$

where i denotes individuals, j neighbourhoods, and t time. Individual wellbeing (Y_{it}) is a function of individual characteristics (X_{it}) and neighbourhood characteristics (N_{jit}) that have been shown to influence wellbeing, and the error (ε_{it}). This model is implemented using the pooled ordinary least squares (OLS) estimator. As we are working with panel data, all standard errors are adjusted for clustering on individuals and for heteroscedasticity. All models are estimated using the "xtreg" command in Stata 15.

In the first stage, we include only the rural-urban dummy to see how large the coefficient on the rural wellbeing advantage is. Next, we add blocks of controls that may explain the rural wellbeing advantage separately. This allows us to see which (block of) variable(s) attenuate the rural advantage the most. Is it individual and household characteristics or the characteristics of places and the local community? All models are nested so that we can compare the same cases across specifications. Last but not least, we include the rural dummy, geodemographic classification, Townsend Score and Access to Healthy Assets and Hazards variables simultaneously to see which factors stand out.

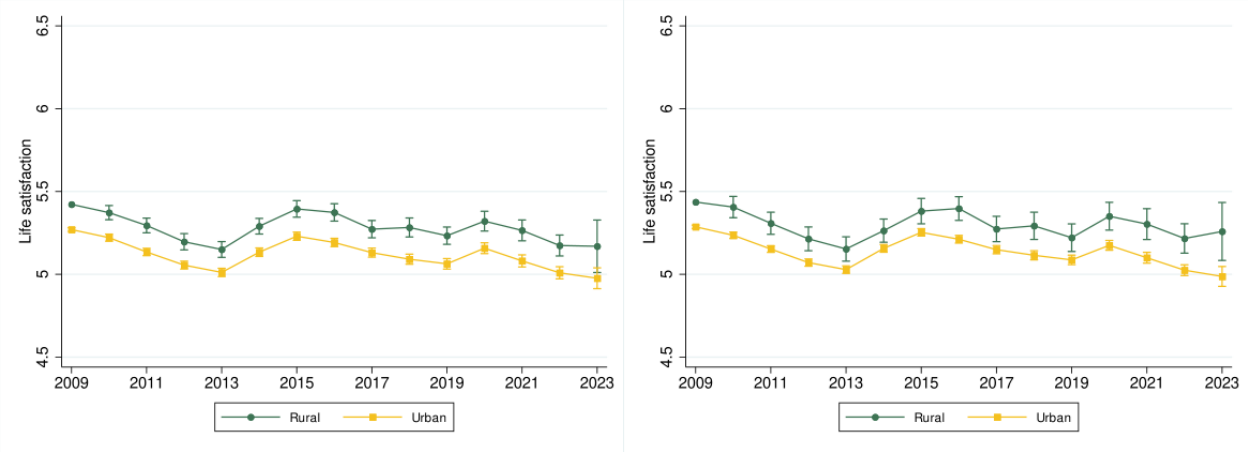
4.3. Results

4.3.1. Evolution of life satisfaction over time by rurality

To set the scene, we will explore how life satisfaction changed from 2009 to 2023, focusing on the differences between rural and urban areas. Figure 4-1 illustrates that life satisfaction is consistently higher in rural areas than in urban areas across various rural–urban classifications. This rural advantage in wellbeing continues over time, although its extent varies. Both rural and urban areas display a recurring cyclical pattern in life satisfaction between 2009 and 2023, rather than following a linear trend. These patterns demonstrate simultaneous rises and declines in both classifications.

Figure 4-1: Mean life satisfaction by rurality (with 95% CI), Great Britain 2009-2023

A) Rural-urban Classification (RUC 2011) B) Degree of Urbanisation (DEGURBA2)

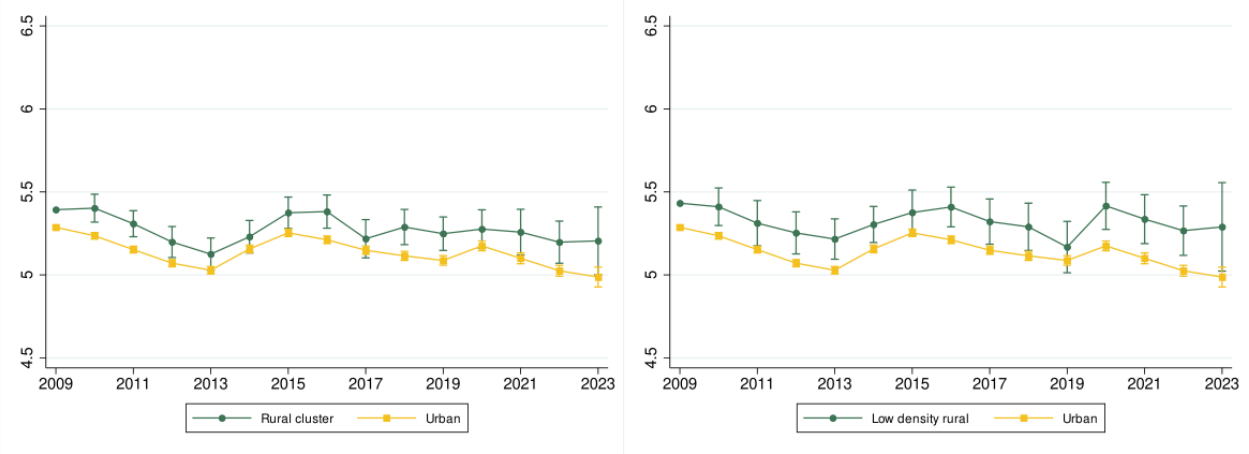


Source: Understanding Society (v20) linked with special licence geodata (v14). Weighted population estimates.

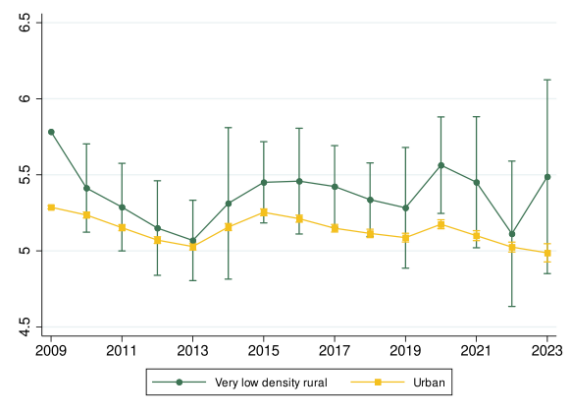
Figure 4-2: Mean life satisfaction by rural area type (DEGURBA2, with 95% CI), Great Britain 2009-2023

Panel A) Rural clusters

Panel B) Low-density rural areas



C) Very low-density areas



Source: Understanding Society (v20) linked with special licence geodata (v14). Weighted population estimates.

While rural wellbeing remains higher overall, urban areas exhibit greater volatility, especially after 2020, which may be linked to the effects of COVID-19. Both rural-urban classification systems convey the same overall narrative: from 2009 to 2023, the population residing in rural areas of Great Britain reports higher wellbeing compared to those in urban areas. Despite fluctuations from year to year, this pattern remains constant, with urban wellbeing consistently

lagging behind that of rural regions. The RUC 2011 measure demonstrates a slightly clearer and more persistent rural wellbeing advantage than the DEGURBA2 classification.

For the DEGURBA2 classification specifically, we can examine whether there are any variations in patterns over time among different rural area types – i.e., rural clusters, low-density rural areas, and very low-density rural areas. Figure 4-2 shows that, across all rural categories, life satisfaction is higher in rural areas than in urban areas. The rural wellbeing advantage is most stable in rural clusters and low-density areas. In low-density rural areas, after 2015, the rural advantage becomes less consistent, but on average, wellbeing remains higher in low-density areas than in urban areas. By contrast, results for very low-density areas are more variable due to wider confidence intervals (due to low sample sizes). Both rural and urban wellbeing exhibit cyclical fluctuations, with notable dips in the mid-2010s and following the 2020 period.

4.3.2. Factors explaining the rural wellbeing advantage

Next, we explore which characteristics of rural (and urban) areas might explain the rural wellbeing advantage. Table 4-3 shows the coefficient of the rural definition (based on the RUC and DEGURBA classifications) within a series of 12 regressions of life satisfaction. The two regressions on the top of the table include the rural definition alone, and the remainder include the rural definition plus one other block of variables (described in Table 4-2).

Table 4-3: Random-effects generalised least squares (GLS) regression of life satisfaction on individual blocks of context variables: Rural-urban coefficient

	RUC 2011			DEGURBA2		
R/U only	b-coef.	0.148	***	b-coef.	0.144	***
	S.E.	0.009		S.E.	0.011	
	R^2	0.003		R^2	0.002	
+OAC 2011	b-coef.	0.075	***	b-coef.	0.062	***
	S.E.	0.011		S.E.	0.014	
	R^2	0.016		R^2	0.016	
+ ACORN 2015	b-coef.	0.058	***	b-coef.	0.039	**
	S.E.	0.009		S.E.	0.013	
	R^2	0.02		R^2	0.02	
+ Area deprivation	b-coef.	0.054	***	b-coef.	0.051	***
	S.E.	0.009		S.E.	0.012	
	R^2	0.016		R^2	0.016	
+ AHAH	b-coef.	0.088	***	b-coef.	0.072	***
	S.E.	0.011		S.E.	0.013	
	R^2	0.004		R^2	0.004	
+ individual characteristics	b-coef.	0.087	***	b-coef.	0.088	***
	S.E.	0.009		S.E.	0.011	
	R^2	0.067		R^2	0.067	

Notes: For complete model results, see **Appendix 11** (A4-2).
Source: Understanding Society (v20) linked with special licence geodata (v14).

Supporting the observations of a rural advantage in Section 4.3.1 above, we find that rurality is significantly and positively associated with life satisfaction in all analyses (models with rural/urban definition only included: β_{RUC} = 0.148, p<0.001; $\beta_{DEGURBA}$ = 0.144, p<0.001). However, this association is reduced when individual- and household-level characteristics (β_{RUC} = 0.087, p<0.001; $\beta_{DEGURBA}$ = 0.088, p<0.001) or contextual characteristics are introduced, with the largest attenuation of the rurality coefficient found when area deprivation (RUC: β_{RUC} = 0.054, p<0.001) and the ACORN classification (DEGURBA: $\beta_{DEGURBA}$ = 0.039, p<0.005) are included. Comparing the impact of adding the OAC or the ACORN classification to the model, we find that the ACORN typology seems to include more of the factors linked to the rural wellbeing advantage (thus, attenuating the rural-urban coefficient more) than the OAC. Furthermore, it is noteworthy that adding in the accessibility and air pollution data explains about as much of the rural wellbeing advantage (i.e., reducing the coefficient to β_{RUC} = 0.088, p<0.001 and $\beta_{DEGURBA}$ = 0.072, p<0.001, respectively) as when we include individual-level controls (albeit, the latter models explain more of the overall variance in life satisfaction).

Next, we assessed four regressions of life satisfaction on variables in all five blocks of variables, substituting both definitions of rurality (RUC, see Table 4-4; DEGURBA, see Table 4-5) and the two geodemographic classifications[25].

Table 4-4: Random-effects generalised least squares (GLS) regression of life satisfaction on rurality, area and individual characteristics by rural-urban indicator (geodemographic classification = OAC 2011), GB 2009-2023

	RUC 2011		DEGURBA	
	b-coef.		b-coef.	
Rural-urban indicator (rural=1)	0.055	***	0.055	***
OAC 2011 (ref. Agricultural communities)				
1A1: Rural Workers and Families	-0.04		-0.039	
1A2: Established Farming Communities	-0.045		-0.039	
1A4: Older Farming Communities	-0.015		-0.008	
1B1: Rural Life	-0.084	*	-0.078	*
1B2: Rural White-Collar Workers	-0.043		-0.037	
1B3: Ageing Rural Flat Tenants	-0.1	*	-0.098	*
1C1: Rural Employment and Retirees	-0.01		-0.007	
1C2: Renting Rural Retirement	-0.066		-0.059	
1C3: Detached Rural Retirement	0.063		0.073	
2: Cosmopolitans	-0.002		-0.002	
3: Ethnicity Central	-0.034		-0.032	
4: Multicultural Metropolitans	-0.118	**	-0.118	**
5: Urbanites	-0.058		-0.056	
6: Suburbanites	-0.048		-0.046	
7: Constrained City Dwellers	-0.132	***	-0.132	***
8: Hard-Pressed Living	-0.143	***	-0.141	***
Other area characteristics:				
Townsend Score of Area Deprivation				
Distance to …	-0.04		-0.039	
… general practitioners	-0.045		-0.039	
… dentists	-0.015		-0.008	
… pharmacies	-0.084	*	-0.078	*
… gambling sites	-0.043		-0.037	
… fast food restaurants	-0.1	*	-0.098	*
… pubs	-0.01		-0.007	
… leisure facilities	-0.066		-0.059	
… blue space	0.063		0.073	
… green space	-0.002		-0.002	
Air pollution	-0.034		-0.032	
… NO2	-0.118	**	-0.118	**
… PM10	-0.058		-0.056	
… SO2	-0.048		-0.046	
Individual and household characteristics	Yes		Yes	
Constant	6.139	***	6.139	***
Number of observations	428880		428880	
Number of individuals	76908		76908	
Rho	0		0.381	
R-squared (within)	0.004		0.004	
R-squared (between)	0.093		0.093	
R-squared (overall)	0.069		0.069	

Notes: For complete model results, see **Appendix 11** (A4-2).
Source: Understanding Society (v20) linked with special licence geodata (v14).

25 The geodemographic classifications could not be analysed simultaneously, due to special licence data access restrictions.

Table 4-5: Random-effects generalised least squares (GLS) regression of life satisfaction on rurality, area and individual characteristics by rural-urban indicator (geodemographic classification = ACORN 2015), GB 2009-2023

	RUC 2011		DEGURBA	
	b-coef.		b-coef.	
Rural-urban indicator (rural=1)	0.046	***	0.045	***
ACORN 2015 (ref. Farms and cottages)				
1: Affluent Achievers	-0.058	*	-0.054	*
2: Rising Prosperity	-0.122	***	-0.118	***
3F22: Larger families in rural areas	-0.114	**	-0.109	**
3F23: Owner occupiers in small towns and villages	-0.11	***	-0.103	**
3G: Successful Suburbs	-0.132	***	-0.128	***
3H: Steady Neighbourhoods	-0.162	***	-0.161	***
3I: Comfortable Seniors	-0.15	***	-0.147	***
3J: Starting Out	-0.125	***	-0.125	***
4: Financially Stretched	-0.184	***	-0.181	***
5: Urban Adversity	-0.209	***	-0.207	***
6: Not Private Households	-0.054		-0.051	
Other area characteristics:				
Townsend Score of Area Deprivation	-0.008	***	-0.008	***
Distance to …				
… general practitioners	-0.005	**	-0.005	**
… dentists	-0.004	**	-0.004	**
… pharmacies	0.002		0.002	
… gambling sites	0.000		0.000	
… fast food restaurants	0.002	*	0.003	*
… pubs	-0.001		-0.001	
… leisure facilities	0.000		0.000	
… blue space	-0.002	*	-0.002	*
… green space	-0.002		-0.002	
Air pollution				
… NO2	0.001		0.000	
… PM10	-0.005	*	-0.005	*
… SO2	-0.031	**	-0.031	**
Individual and household characteristics	Yes		Yes	
Constant	6.219	***	6.219	***
Number of observations	428880		428880	
Number of individuals	76908		76908	
Rho	0.38		0.381	
R-squared (within)	0.004		0.004	
R-squared (between)	0.093		0.093	
R-squared (overall)	0.069		0.069	

Notes: For complete model results, see **Appendix 11** (A4-2).
Source: Understanding Society (v20) linked with special licence geodata (v14).

Firstly, we note that the rural wellbeing advantage reduces to about 32-38% of its original size (OAC: β_{RUC} and $\beta_{DEGURBA}$ = 0.055, p< 0.001; ACORN β_{RUC} = 0.046, p< 0.001; $\beta_{DEGURBA}$ = 0.045, p< 0.005) when we include all five blocks of individual and neighbourhood context variables simultaneously. The "black box" rural advantage in life satisfaction remains evident in these models, controlling for a vast range of contextual factors.

Two-thirds of the raw rural advantage in life satisfaction can be attributed to individual and neighbourhood characteristics, which are also associated with life satisfaction themselves. Specifically, this analysis found evidence of significant associations between neighbourhood characteristics - measured using geodemographic typologies - and life satisfaction. Considering firstly the analyses which include the OAC typology (see Table 4-4), we find that reported life satisfaction in the "Agricultural Communities" reference category was relatively higher than in most neighbourhood types, although few of these differences (five out of 16 categories for both rural-urban classification measures) were significant at the 95% confidence level (in support of H4). The results for the different rural-urban

classifications vary insignificantly; for parsimony, we will refer to only the results using the RUC (which is the more frequently used classification for GB). Residents within "Hard-Pressed Living" neighbourhoods reported the lowest life satisfaction compared with those in "Agricultural Communities" (RUC: $\beta_{\text{Hard-Pressed Living}} = -0.143$, $p < 0.001$), which is in support of H7. Individuals living in "Constrained City Dwellers" neighbourhoods, which are also associated with urban economic disadvantage, also reported significantly lower life satisfaction than the reference (RUC: $\beta_{\text{Constrained City Dwellers}} = -0.132$, $p < 0.001$). Meanwhile, there was no significant difference in life satisfaction between the "Urbanites" and "Cosmopolitans" neighbourhood types and the "Agricultural Communities" areas (H5), or between "Suburbanites" and "Agricultural Communities" (H6). Separately, it is notable that residents in "Multicultural Metropolitans" neighbourhoods, reflecting lower-income areas associated with overseas migrants and mixed ethnic backgrounds (Office for National Statistics 2015), show significantly lower life satisfaction compared with "Agricultural Communities" (RUC: $\beta_{\text{Multicultural Metropolitans}} = -0.118$, $p < 0.01$). While residents in all rural neighbourhood types (OAC group 1) reported lower life satisfaction than those in agricultural communities, only the differences with "Rural Life" and "Ageing Rural Tenants" reach statistical significance.

Considering the ACORN classification (see Table 4-5), we find that living in areas classified as "Farms and cottages" was positively associated with life satisfaction (H1), as coefficients for all other neighbourhood types were negative, and statistically significant except for "Not Private Households" (signifying communal dwellings). Again, the results for the different rural-urban classifications vary insignificantly and we will refer to only the results using the RUC definition. The "Affluent Achievers" areas, which signify wealthy suburban neighbourhoods, report marginally (but significantly) lower life satisfaction compared with the "Farms and cottages" reference category (RUC: $\beta_{\text{Affluent Achievers}} = -0.058$, $p < 0.05$). Other categories reflecting suburban affluence ("Rising Prosperity", "Successful Suburbs"), too, report significantly lower life satisfaction, albeit at a higher level of statistical confidence (e.g., $\beta_{\text{Rising Prosperity}} = -0.122$, $p < 0.001$) (H2). There is a much larger difference in life satisfaction between areas of lower urban incomes and deprivation ("Financially Stretched" and "Urban Adversity") and the "Farms and cottages", shown by the relatively large negative coefficients (e.g., RUC $\beta_{\text{Urban Adversity}} = -0.209$, $p < 0.001$) (H3). Residents in both rural neighbourhood types ("Larger families in rural areas" and "Owner-occupiers in small towns and villages") have lower life satisfaction than those on farms and in cottages, with both differences reaching statistical significance.

Evaluation of the effects of other area characteristics revealed further associations between the characteristics of local areas and life satisfaction. Increasing area deprivation, measured using the Townsend Deprivation Score, was significantly negatively associated with life satisfaction in all four regressions (H8). Nuanced contextual effects emerge when access to retail and health services are considered. Access to GP practices and dentists were significantly negatively associated with life satisfaction, but this was not the case for pharmacists (no significant associations found) (H9). Distance to leisure facilities, gambling establishments and pubs were not significantly associated with life satisfaction, but there was a consistent positive association between fast food outlets and life satisfaction (H10). Similarly, some – but not all – types of air pollution (particulate matter and Sulphur dioxide, but not nitrogen dioxide) were significantly, negatively associated with life satisfaction (H11). Surprisingly, proximity to (passive) green and blue space were not associated with greater life satisfaction (H12).

Following this, we compare the contextual predictors of life satisfaction in the rural and urban samples, to identify potential drivers of the rural advantage in wellbeing. Results for the OAC are shown in Table 4-6; results for the models using ACORN are shown in Table 4-7. Unlike the models based on the whole sample, we can see that the associations of neighbourhood characteristics with life satisfaction vary considerably across models, both within rural areas when a different rural-urban classification is used and when comparing rural and urban residents (i.e., holding the rural-urban definition constant).[26]

26 Differences in results across the two rural-urban classifications may be driven by differences in which sample members are classified as rural (and urban). The rural sample is considerably smaller when we use DEGURBA2 (N = 9801) than when we use RUC (N = 17843), meaning we have more statistical power to detect rural area effects using the RUC. Differences in results across the two geodemographic classifications are trickier to interpret. The OAC geodemographic classification follows more closely the rural-urban definition of the RUC: it considers rurality as one of the key stratifying variables, putting almost all areas with a population of less than 10k into the "Countryside

Table 4-6: Random-effects generalised least squares (GLS) regression of life satisfaction on area and individual characteristics by rural-urban indicator (geodemographic classification = OAC 2011), GB 2009-2023

	RUC 2011				DEGURBA2			
	Rural area		Urban area		Rural area		Urban area	
	b-coef.		b-coef.		b-coef.		b-coef.	
OAC 2011 (ref. Agricultural communities)								
1A1: Rural Workers and Families	-0.046		0.547	*	-0.029		-0.181	
1A2: Established Farming Communities	-0.016		-0.061		-0.027		-0.144	
1A4: Older Farming Communities	0.022		0.239		0.025		-0.154	
1B1: Rural Life	-0.073		0.280		-0.050		-0.263	**
1B2: Rural White-Collar Workers	-0.029		0.292		-0.007		-0.185	*
1B3: Ageing Rural Flat Tenants	-0.102	*	0.225		-0.137	**	-0.204	*
1C1: Rural Employment and Retirees	0.027		0.556	*	0.059		-0.270	
1C2: Renting Rural Retirement	-0.101		0.289		-0.098		-0.200	*
1C3: Detached Rural Retirement	0.127	*	0.304		0.171	*	-0.149	
2: Cosmopolitans	-0.471		0.294		1.118	**	-0.185	*
3: Ethnicity Central	1.276	***	0.258		0.000		-0.217	**
4: Multicultural Metropolitans	-0.239		0.182		-0.005		-0.300	***
5: Urbanites	-0.042		0.253		-0.021		-0.236	**
6: Suburbanites	-0.043		0.268		-0.009		-0.222	**
7: Constrained City Dwellers	-0.033		0.159		0.073		-0.317	***
8: Hard-Pressed Living	-0.137	***	0.163		-0.129	**	-0.321	***
Other area characteristics:								
Townsend Score of Area Deprivation	-0.008		-0.012	***	-0.002		-0.013	***
Distance to …								
… general practitioners	-0.001		-0.008	*	0.000		-0.006	*
… dentists	-0.003	*	-0.010	**	-0.003	*	-0.008	**
… pharmacies	0.001		0.005		0.001		0.004	
… gambling sites	0.000		0.000		0.000		0.000	
… fast food restaurants	0.001		0.006	*	0.001		0.004	*
… pubs	-0.001		-0.005		0.000		-0.006	**
… leisure facilities	0.000		-0.002	*	0.000		0.000	
… blue space	0.000		0.000		0.000		-0.001	
… green space	-0.020		0.000		-0.010		-0.001	
Air pollution								
… NO2	-0.009	*	0.001		-0.012		0.000	
… PM10	-0.002		-0.005		-0.007		-0.004	
… SO2	0.062	*	-0.034	**	0.074		-0.031	**
Individual and household characteristics	Yes		Yes		Yes		Yes	
Constant	5.776	***	5.879	***	5.784	***	6.330	***
Number of observations	98885		329995		51952		376928	
Number of individuals	17843		62486		9801		69443	
Rho	0.368		0.385		0.372		0.382	
R-squared (within)	0.002		0.004		0.003		0.004	
R-squared (between)	0.084		0.091		0.079		0.092	
R-squared (overall)	0.056		0.071		0.053		0.07	

Notes: For complete model results, see **Appendix 12** (A4-3).
Source: Understanding Society (v20) linked with special licence geodata (v14).

It is notable that area deprivation has significant negative associations with life satisfaction for urban residents, only, and that this pattern is present for all four rural-urban comparisons (i.e., the combinations of the RUC and

communities" group and then differentiating between community types within-group. Thus, the rural RUC sample will have very few urban cases and vice versa. The ACORN typology, by contrast, is not stratified by degree of urbanisation and cases can straddle more easily both rural-urban definitions. Due to resource constraints, we could not experiment with recoding geodemographic types straddling the rural-urban categories (yet) and unfortunately, we cannot compare the two geodemographics simultaneously due to restrictions on the number and types of data that can be linked under special licence arrangement.

DEGURBA2 definitions of rurality, and the OAC and ACORN geodemographic typologies). In terms of access to health facilities, greater distance to GPs is significantly negatively associated with life satisfaction in all urban regressions, but this is not the case for any of the rural analyses. By contrast, greater distance to dentists significantly reduces life satisfaction in all models: rural and urban. There is also evidence of a greater sensitivity of life satisfaction to service access within urban areas, as significant associations for distance to fast food restaurants, pubs and leisure facilities are only found in the urban sample. The direction of these urban associations was always positive for fast food restaurants and always negative for pubs and leisure facilities.

Table 4-7: Random-effects generalised least squares (GLS) regression of life satisfaction on area and individual characteristics by rural-urban indicator (geodemographic classification = ACORN 2015), GB 2009-2023

	RUC 2011				DEGURBA2			
	Rural area		Urban area		Rural area		Urban area	
	b-coef.		b-coef.		b-coef.		b-coef.	
ACORN 2015 (ref. Farms and cottages)								
1: Affluent Achievers	-0.049		-0.028		-0.035		-0.121	
2: Rising Prosperity	-0.123	**	-0.093		-0.156	*	-0.185	**
3F22: Larger families in rural areas	-0.122	**	-0.102		-0.106	*	-0.177	*
3F23: Owner occupiers in small towns and villages	-0.116	***	-0.067		-0.106	**	-0.150	*
3G: Successful Suburbs	-0.103	**	-0.107		-0.067		-0.202	**
3H: Steady Neighbourhoods	-0.146	**	-0.135		-0.219	**	-0.229	**
3I: Comfortable Seniors	-0.146	**	-0.116		-0.194		-0.213	**
3J: Starting Out	-0.232	**	-0.096		0.161		-0.196	**
4: Financially Stretched	-0.196	***	-0.156		-0.195	***	-0.251	***
5: Urban Adversity	-0.213	***	-0.178		-0.262	**	-0.273	***
6: Not Private Households	0.067		-0.087		0.145		-0.145	
Other area characteristics:								
Townsend Score of Area Deprivation	-0.004		-0.010	***	0.004		-0.009	***
Distance to …								
… general practitioners	-0.001		-0.008	*	0.000		-0.006	*
… dentists	-0.003	*	-0.010	**	-0.003	*	-0.008	**
… pharmacies	0.001		0.005		0.000		0.004	
… gambling sites	0.000		0.000		0.000		0.000	
… fast food restaurants	0.001		0.006		0.001		0.004	*
… pubs	0.000		-0.006		0.000		-0.006	**
… leisure facilities	0.000		-0.002	*	0.000		0.000	
… blue space	-0.001		0.000		0.000		-0.001	
… green space	-0.017		-0.002		-0.001		-0.003	
Air pollution								
… NO2	-0.009	*	0.002		-0.010		0.001	
… PM10	-0.002		-0.005		-0.007		-0.004	
… SO2	0.061	*	-0.036	***	0.067		-0.034	***
Individual and household characteristics	Yes		Yes		Yes		Yes	
Constant	5.849	***	6.236	***	5.859	***	6.300	***
Number of observations	98885		329995		51952		376928	
Number of individuals	17843		62486		9801		69443	
Rho	0.368		0.385		0.373		0.382	
R-squared (within)	0.002		0.004		0.003		0.004	
R-squared (between)	0.085		0.091		0.078		0.093	
R-squared (overall)	0.056		0.071		0.053		0.07	

Notes: For complete model results, see Appendix 12 (A4-3).
Source: Understanding Society (v20) linked with special licence geodata (v14).

We also observe distinct results for variables reflecting forms of air pollution: increased sulphur dioxide (SO2) pollution significantly reduces life satisfaction in all urban analyses, but this is not the case in any of the rural samples. In fact, unusually, SO2 has a significant positive effect on life satisfaction in two rural models. As higher SO2 levels in rural areas are linked to biomass or coal burning, agriculture, and small-scale industries, combined with transport of pollutants from elsewhere, this could indicate living in rural areas with greater economic activity. Conversely, nitrogen dioxide (NO2) pollution is negatively associated with life satisfaction in all rural samples (twice significantly), but this is not the case in any urban samples. In rural areas, background air is usually cleaner, so when NO_2 levels rise, the effects are more noticeable (smell, haze, irritation) and may have a stronger impact on wellbeing. In urban areas, by contrast, high NO_2 is normal. Therefore, our analysis finds support for H13, but not H14.

Table 4-8: Summary of hypotheses and results

Hypotheses	Hypothesis supported?
ACORN 2015 related:	
H1: Residents in “Farms and Cottages” areas report higher life satisfaction than those in most other ACORN categories, due to greater environmental quality and social cohesion.	yes
H2: Affluent suburban categories (e.g., “Affluent Achievers”) may report life satisfaction levels similar to or higher than “Farms and Cottages”, reflecting economic security and service access.	no
H3: Deprived urban categories (e.g., “Urban Adversity”) are expected to report significantly lower life satisfaction than “Farms and Cottages.”	yes
OAC 2011 related:	
H4: Residents in “Agricultural Communities” report higher life satisfaction than those in most other OAC groups, reflecting strong community ties and environmental advantages.	yes
H5: Residents in “Urbanities” and “Cosmopolitans” are expected to report lower life satisfaction compared to “Agricultural Communities” due to higher exposure to deprivation and pollution.	no
H6: Residents in “Suburbanites” may show similar or higher life satisfaction compared to “Agricultural Communities,” given their socioeconomic advantages and good service access.	no
H7: Residents in “Hard-Pressed Living” areas are expected to report the lowest life satisfaction relative to “Agricultural Communities.”	yes
Other neighbourhood-related:	
H8: Higher area deprivation (Townsend score) is associated with lower life satisfaction.	yes
H9: Greater distances to health services are associated with lower life satisfaction.	partly (not pharmacies)
H10: Proximity to leisure facilities is associated with higher life satisfaction, while accessibility to unhealthy outlets (fast food outlets, pubs and gambling outlets) is associated with lower life satisfaction.	no
H11: Higher levels of air pollution (NO_2, PM_{10}, SO_2) are associated with lower life satisfaction.	partly (not NO2)
H12: Proximity to blue space and passive green space is associated with higher life satisfaction.	no
For rural and urban areas specifically, we hypothesise:	
H13: In rural areas, deprivation, access to services and unhealthy outlets have weaker associations with life satisfaction than they do in urban areas, reflecting adaptation to lower accessibility and lower prevalence.	yes
H14: In both rural and urban areas, access to leisure facilities, green and blue space, and lower air pollution are positively associated with life satisfaction.	no

Lastly, due to our selection of a rural reference category (reflecting farming communities) in the two geodemographic classifications, we restrict our interpretation of associations between the geodemographic neighbourhood types and life satisfaction to rural respondents only. Considering the OAC classification, we find that places associated with “Ageing Rural Flat Tenants” report significantly lower life satisfaction than “Agricultural communities” for both rural/urban definitions (RUC: $\beta_{\text{Ageing Rural Flat Tenants}} = -0.102$, $p < 0.05$; DEGURBA 2: $\beta_{\text{Ageing Rural Flat Tenants}} = -0.137$, $p < 0.05$), while “Detached Rural Retirement” has relatively higher life satisfaction (RUC: $\beta_{\text{Detached Rural Retirement}} = 0.127$, p

< .05; DEGURBA 2: $\beta_{\text{Detached Rural Retirement}} = 0.171$, $p < 0.05$). These results suggest that differences in the quality of the environment in retirement locations – potentially associated with wealth, or higher population densities – could influence wellbeing differences within rural areas. Secondly, we find that the "Cosmopolitans" neighbourhood type reports significantly higher life satisfaction than "Agricultural communities" for DEGURBA 2-based rural areas ($\beta_{\text{Cosmopolitans}} = 1.118$, $p < 0.01$), and comparatively higher wellbeing was found in localities defined as "Ethnicity Central" neighbourhoods, for the 10k rural/urban threshold ($\beta_{\text{Ethnicity Central}} = 1.276$, $p < .001$). Although these results may be influenced by very low numbers of rural respondents from these typically urban locations, it is possible that the relative vibrancy and diversity of similar locations could positively affect rural life satisfaction.

The results for the ACORN 2015 classification in rural areas suggest a more consistent pattern, as almost all types of neighbourhoods report lower wellbeing than the "Farms and cottages" type.

4.4. Discussion

This analysis of rural-urban differences in life satisfaction and the contextual factors affecting these differences has demonstrated the value of a nested, multi-scale analysis, the inclusion of consistent quantitative and spatial measurements of context, and detailed data linkages to a multi-year, high-n panel survey. The analysis described in this section contributes to the developing literature on the specific routes and mechanisms that drive rural wellbeing advantages, which also supports an understanding of life in left-behind communities. In both a longitudinal analysis of differences in average life satisfaction between rural and urban areas, and an evaluation of predictors of life satisfaction at multiple scales, we find strong evidence of the existence of a 'paradoxical' rural wellbeing advantage within Great Britain. Across several regression analyses, rurality was found to be significantly and positively associated with life satisfaction. However, this association was reduced when neighbourhood-level contexts were introduced, and this was particularly the case for area deprivation, which had a consistent negative effect on life satisfaction. Subtle, contextual 'neighbourhood effects' appear to be present, as associations between other measures of local areas - including air pollution, geodemographic neighbourhood types, and the accessibility of services and facilities - and life satisfaction were not consistently statistically significant and were not always in the direction expected; similarly, measures of access to green and blue spaces did not emerge as significant predictors of life satisfaction. Through a comparison of the neighbourhood and area-level predictors of life satisfaction in the rural and urban samples, we provide new insights into potential drivers of the rural advantage in life satisfaction. We found that certain characteristics of local areas—deprivation, distance to GP practices, and sulphur dioxide pollution—are significant predictors of life satisfaction in urban areas only. In particular, the quality of the environment in retirement neighbourhoods and the vibrancy of more 'cosmopolitan' locations could drive higher life satisfaction in some rural areas.

The measurements of rurality, deprivation, pollution, and access to multiple facilities and services included in the analysis were consistent, objective metrics that were calculated at a granular (LSOA) scale. Area typologies reflecting socio-economic diversity were also included for sub-LSOA units. However, this highly detailed information on rural diversity has important limitations. Firstly, as LSOAs are drawn using a population threshold, their spatial areas are not consistent. In rural regions, similar geographies have irregular and non-compact boundaries, and are less likely to reflect meaningful neighbourhoods (Flowerdew, Feng and Manley 2007, who analysed the 2001 Data Zones in Scotland), potentially affecting the detection of neighbourhood effects (Flowerdew, Manley and Sabel 2008). Additionally, the results for area deprivation (a consistent negative predictor of life satisfaction for the overall and urban samples, but not the rural samples) may reflect, to some extent, the composition of the Townsend Deprivation Score, which is calculated using some variables with a possible 'urban bias', including households not owning a car. The development of rural-specific deprivation measures, rather than national metrics, has been recommended (Burke and Jones 2019), but is beyond the scope of this analysis. Thirdly, our analysis does not account for individual moving trajectories, changes in the characteristics of local areas over time, and some contextual factors are not measured at an ideal frequency to link exposure with outcomes. For example, rurality may change through new building or settlement growth, while broader trends in socio-economic development, services, and the environment also evolve but are only intermittently captured. Although some changes in rurality may not reflect place-specific processes (e.g., a settlement crossing the 10k population threshold), measuring place-based, multidimensional changes over time would be a valuable next step to support analysis of the links between places being "left behind" and wellbeing. Linking publicly available neighbourhood context measures enabled us to examine multiple dimensions simultaneously and maintain comparability across measures; however, it restricts our ability to

capture more immediate or seasonal effects, such as those of pollutants. Ideally, exposures such as nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) should be measured at or close to the time of interview, given that surveys like UKHLS are conducted throughout the year. This would allow researchers to account for well-established seasonal patterns, including winter peaks in pollution driven by heating demand and temperature inversions, spring and autumn spikes linked to agricultural burning, and summer declines in NO_2 and SO_2 alongside increases in ozone. Such temporal alignment would improve the capacity to assess how environmental exposures shape wellbeing (as we will see in Section 5).

5. Leveraging POI Data on Public Infrastructure: Wind turbines and Quality of Life in Germany

5.1. Introduction

Linked panel data enriched with place-of-interest (POI) coordinates for public infrastructure offer powerful opportunities for understanding rural wellbeing dynamics over time. Fine-grained POI-level data enable precise measurement of proximity and exposure, which is crucial for accurately capturing environmental gradients. In rural contexts, POI-based approaches are particularly advantageous over administrative data linkage because rural spatial entities, such as municipalities, counties, or postal codes, are, on average, significantly larger and more heterogeneous than their metropolitan counterparts. POI-based linkage enables more precise modelling of exposure and access to essential services, such as healthcare and education, which are often more limited in rural areas, revealing spatial patterns that municipality or county-level data would obscure (see, e.g., Ortega-Reig, Schürmann et al. 2023).

By geo-linking high-frequency longitudinal survey responses based on the precise location of the respondents' homes to the precise locations and installation dates of nearby facilities—such as landfills, waste incinerators, animal farms, and renewable energy sites, to name but a few—researchers can exploit within-individual variation in exposure to isolate causal effects on different aspects of subjective wellbeing. This approach addresses key identification challenges in local context effects research, including residential self-selection, unobserved time-invariant heterogeneity, and aggregation bias that often plague cross-sectional municipality or county-level analyses, see, e.g., Knies and Melo (2019).

As a case study of this methodology, we examine the health-related quality of life (HRQoL) impacts of onshore wind turbine installations in Germany. Over the past three decades, onshore wind capacity in Germany has surged, spurred by the 1991 Act on Supplying Electricity from Renewables (StrEG) and the 2000 Renewable Energy Sources Act (EEG), with over 30k turbines operational by April 2023 (Bundesnetzagentur 2023). While wind power offers substantial climate and economic benefits (e.g., Gavard, Göbel and Schoch 2025), turbines also generate aerodynamic noise, low-frequency sound, shadow flicker, and visual prominence—all potential stressors for nearby residents (Shepherd, McBride et al. 2011, Bakker, Pedersen et al. 2012, Berger, Ashtiani et al. 2015).

By exploiting variation in the timing and proximity of turbine installations to respondents' homes, we isolate within-individual changes in the SF-12 physical (PCS) and mental component scores (MCS). Reporting both PCS and MCS enables us to distinguish whether wind turbine exposure primarily affects somatic functioning (e.g., sleep disruption) versus psychological wellbeing (e.g., annoyance, stress), thereby informing targeted mitigation and policy measures. By combining rich longitudinal health information with detailed spatial coordinates of wind turbine locations, we identify individuals' dynamic exposure trajectories over time and control for all time-invariant individual heterogeneity. This approach mitigates bias from unobserved characteristics such as baseline health status, residential preferences, or noise sensitivity—common threats in cross-sectional studies.

While a small number of studies have leveraged SOEP data to assess the wellbeing effects of wind turbine exposure, their empirical designs leave room for refinement. von Möllendorff and Welsch (2017) analyse life satisfaction data from SOEP for 1994-2012 using postcode-level wind capacity aggregates, showing small negative wellbeing effects of wind turbines. The use of aggregated data may, however, mask heterogeneity in individual exposure, particularly in rural areas, which have large postcode areas (particularly in the North and East of Germany, which also happen to have the greatest prevalence of wind turbines). Krekel and Zerrahn (2017), using SOEP data for 2000-2017, apply a within-individual difference-in-differences framework exclusively to residents in rural municipalities and focus on life satisfaction rather than HRQoL; they report a modest negative effect on life satisfaction, and note in a footnote that SF-12 scores show no significant change. Krekel, Rode and Roth (2023) link SOEP respondents 2000-2017 to wind turbine coordinates and exploit the staggered rollout in a spatial event-study with two-way fixed effects; they find no evidence of adverse effects on general health, physical, or mental SF-12 scores, self-assessed health, doctor visits, or county-level suicide rates. While Krekel and Zerrahn (2017) adopted a rigid causal estimation strategy including matching on individual and place characteristics and implementing ban radii to distinguish treated and

untreated cases clearly, Krekel, Rode and Roth (2023), in effect, estimate a cross-sectional model with additional controls for individual and neighbourhood unobserved heterogeneity.

5.2. Data and methods

5.2.1. German Socio-economic Panel Study (SOEP)

We use the German Socio-Economic Panel (SOEP, v.39) from 2002 to 2022. SOEP is a high-quality representative panel of private households in Germany, surveying around 30k people in 11k households annually (Wagner, Frick and Schupp 2007). The study began in 1986 and contains data on a wide range of economic and social topics, see http://companion.soep.de/index.html. Since 2000, SOEP has included information on the exact location of respondents' homes, allowing us to combine data on wellbeing with wind turbine data.[27]

Our study focuses on the mental and physical component score of health-related quality of life (HRQoL) from the Short Form-12 Health Questionnaire (SF12v2) (Ware, Kosinski and Keller 1996). The SF-12 has been surveyed in the SOEP biennially since 2002. The scores are calibrated to the German population in 2004 and range between 0 and 100, with a lower score indicating lower HRQoL in the respective dimension. A score of 50 represents the average value of the standard population, while a score of 60 indicates a HRQoL that is one standard deviation higher than the standard population (Nübling, Andersen et al. 2007).

5.2.2. Core Energy Market Registry (MaStR)

Our study examines the impact of wind turbines located within a 6 km radius of respondents' homes. We extracted the exact geographical coordinates, commissioning date (and decommissioning date, where applicable), hub height, and capacity of wind turbines from the April 1, 2023 version of the Core Energy Market Registry (MaStR) (Bundesnetzagentur 2023), a register containing information on all power generation plants in Germany.[28] Additionally, we used the Renewable Energy Monitor of the Centre for Environmental Research; this is based on the MaStR version of May 31, 2021.[29]

In total, we have information on 34,454 wind turbines in Germany, of which 32,612 are onshore. 23,600 onshore wind turbines are relevant to our investigation, which were built between January 2, 2002, and December 30, 2022. 695 of these turbines have missing geographical information after our extensive data cleaning efforts; they are mostly small systems with a capacity of less than 30 kW for which entering the exact location is not required.

Core Energy Market Registry

The MaStR is an official register for the electricity and gas market, established under Sections 111e and 111f of the Energy Industry Act and the Ordinance on the Registration of Energy Industry Data (MaStRV).

The register began in 2014 and includes information on all facilities connected to the electricity and gas grids. Plant operators are required to register their facilities and provide the necessary information. The MaStR is publicly accessible at the following link:

https://www.marktstammdatenregister.de/MaStR

The database is not designed for longitudinal A significant amount of data cleaning is required for visualisations like the Renewable Energy Monitor:

https://web.app.ufz.de/ee-monitor/

Table 5-1 shows distributional statistics on hub height and capacity of onshore wind turbines in Germany. Wind turbines have an average hub height of 99.8 m (Median: 98 m, p50) and an average capacity of 2200.6 kW (Median: 2000 kW). The bulk of wind turbines with a hub height of 50 m or more have a capacity of 625 kW (10th percentile

27 Coordinates and data from the interview are never available at the same time to researchers, and the analysis has to be undertaken in a secure setting at the premises of the DIW Berlin, the data custodians.

28 We had started this project with a more detailed version of the MaStR (dated March 13, 2023). The version was not officially archived, however. To allow others to replicate our analysis, we decided to switch to the MaStR dated April 1, 2023. This is the first official archived version of the MaStR. Some of the variables we used to clean the wind turbine data needed for this analysis are not included in the archived data.

29 For a description of the data cleaning processes that went into the production of an earlier release of the renewable energy monitor, see Eichhorn, Scheftelowitz et al. (2019).

value, p10), while the bulk of the wind turbines with a capacity of 500 kW or more are over 64 m tall (10th percentile value, p10). Note that these numbers are based on all onshore wind turbines observed in the Core Energy Registry, not just the ones relevant to our analysis.

Table 5-1: Wind turbines in Germany, hub height and capacity

	Mean	Min	Max	p10	p50	p90	N
Hub height (in metres)							
All heights	99.8	3	200	63	98	143	31973
Greater or equal 50 m	102.1	50	200	64	100	148	30837
Greater or equal 100 m	128.8	100	200	100	135	159.4	15479
Capacity greater or equal 500 kW	101.4	30	200	64	99	145	31180
Net capacity (in kW)							
All heights	2206.0	0.5	20000	600	2000	3600	31996
Greater or equal 50 m	2276.3	80	20000	625	2000	3600	30838
Greater or equal 100 m	2999.2	600	20000	2000	2780	4800	15480
Capacity greater or equal 500 kW	2258.3	500	20000	600	2000	3600	31188

Source: Core Energy Market Data Register (MaSTR, version of April 1, 2023 with own corrections).

5.2.3. Treatment, treatment radius and ban radius specification

It is still uncertain what negative impact wind turbines might have on the health of nearby residents. In Germany, there is no general legislation that applies to wind turbine construction. However, according to the Federal Building Code (Bundesbaugesetz), installations with a height above 50 m require approval to ensure that they do not cause any harm to the environment, including people and nature. Enforceable minimum distances from settlements range from 600 m to 1 km. The so-called impact radius, which officials use to evaluate the impact of wind turbines on the environment, varies from 1 km to 6 km for turbines with a hub height of 100 m or above. These considerations lead us to examine the health impacts of four sets of wind turbines:

(1) any wind turbines,

(2) only wind turbines with a hub height of 50 m or more,

(3) only wind turbines with a hub height of 100 m or more,

(4) wind turbines with a capacity of 500 kW.

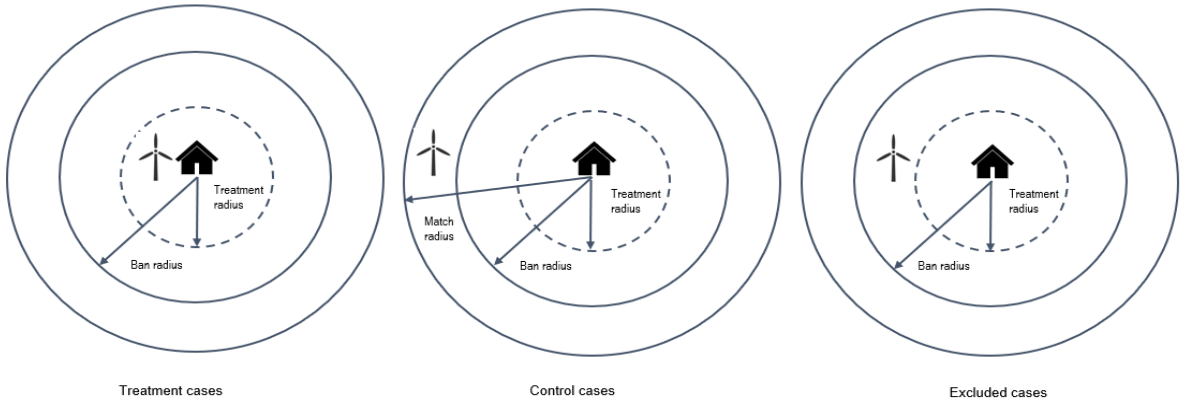
For all sets of wind turbines, we consider distances ranging from 1 km to 6 km (i.e., the entire impact radius). In terms of direct health impacts, a significant contributor may be infrasound (which remains unobserved in our study). Although the level of infrasound is often below the threshold of hearing, some residents may become sensitised to the vibrations transmitted through floors and beds or to higher-frequency, audible sounds generated by structural resonance. When sensitisation occurs, these individuals can experience symptoms akin to chronic stress, engaging the autonomic nervous system similar to how it reacts to other phobias (Flemmer and Flemmer 2023). Empirical estimates of infrasound audibility vary, ranging from inaudible at short distances (Jakobsen 2005) to perception thresholds of up to 4 km (Zajamšek, Hansen et al. 2016). While the impact of wind turbines is hypothesised to be more marked in the smaller radii, the quasi-experimental treatment group is more representative of households across the country the larger the radius (given the low number of treated cases we are likely to observe in our nationally representative panel study that does not include boost samples of localities with local wind turbine installation plans).

To distinguish clearly between the treatment and control groups, we introduce a ban radius of up to 10 km. Notably, while elephants are known to communicate over distances of up to 10 km using infrasound (Fleur 2012), we would not anticipate significant effects on human health and wellbeing beyond this range. There are no strict and fast rules regarding the ban radius; in fact, a recent paper using earlier editions of SOEP and wind turbine data decided not to implement a ban radius at all (Krekel, Rode and Roth 2023). The omission of a ban radius in that study might contribute to the overall null effects on a range of health outcomes (including the SF-12 that we examine here). Residents who experience the construction of a wind turbine within the ban radius but outside the treatment radius are excluded from the radius-specific treatment group.

5.2.4. Allocation to quasi-experimental groups

To select our quasi-experimental analysis samples, we use the survey respondents' SF-12 reports and the 'as the crow flies' distance between their address coordinates and all wind turbine locations. We specify a radius of 15 km around each individual, within which the presence of a wind turbine can trigger a person's assignment to the treatment or control group. For each interviewee and each SF-12 survey date, we check whether a wind turbine is within the treatment radius *r*=1(1)6 km and no wind turbines in the respective ban radius spanning from *r* to 10 km. Likewise, we check whether there are any turbines within a 10-15 km radius.

Figure 5-1: Illustration of allocation to treatment and control group based on placement of wind turbines in the treatment, ban and match radii



Source: Own illustration.

To be allocated to either the treatment or control group, individuals must have provided at least two valid SF-12 surveys representing the possible assessment occasions t_0 and t_1, not have had a wind turbine within 0-10 km at t_0[30] and not have moved homes between t_0 and t_1.[31] Individuals are screened into the radius-specific treatment group if they have any wind turbines within a radius of r=1(1)6 km from their home and none in the radius-specific ban radius spanning from *r* to 10 km in t_1. Individuals who have any wind turbine within a radius of 10 to 15 km and no wind turbine within 10 km of their home in t_1 are eligible for the control group. Where multiple pairs of observations could serve as t_0 and t_1 assessment occasions, preference is given to those closest to any wind turbine treatment

30 We have had access to the coordinates of respondents' homes since 2000. Before selecting cases for our study, we excluded those observed to live close to a wind turbine before providing two SF-12 surveys. For instance, an interviewee may have lived near a wind turbine as a non-interviewed child in their parental home from 2000 to 2010, but then moved to a home of their own with no wind turbine in the treatment radius and later on with a wind turbine in the treatment radius. The case will not enter the analytical sample because we know the interviewee lived close to a wind turbine previously.

31 Some proportion of the sample provides multiple SF-12 surveys; if multiple occasions qualify for t0 and t1, the SF-12 pair nearest in time to the treatment date is picked. For example, consider individual A, who has reported SF-12 in 2002, 2004, 2006, and 2008, has lived at the same address since 2000, and had no wind turbine within a 0-10 km radius in 2002 and 2004. When a wind turbine was constructed within 5 km distance to the home in 2005, the SF-12 reported in 2002 and 2004 could be used as t0, and the SF-12 in 2004, 2006, and 2008 could be used as t1 occasions. We picked 2002 as t0 and 2004 as t1.

observed. Individuals who are in any treatment group at a later stage in the survey are excluded from the control group at earlier stages in the study.

See **Appendix 13** (A5-1) for a description of all samples with respect to the respondents' socio-demographic and socio-economic characteristics (age, gender, education, employment status, marital status, personal earned income, net household income) and characteristics of their living environment (type of residential area, type of building, degree of rurality, unemployment rate in the district (BBSR 2022), proportion of road traffic area in the total area of the municipality (Leibniz Institute of Ecological Urban and Regional Development 2023), which have an explanatory power for differences in health-related quality of life, see e.g. Ellert und Kurth (2013).

5.2.5. Empirical model

To examine whether there is a causal relationship between health-related quality of life and the presence of wind turbines in the immediate residential area, we use a so-called difference-in-differences (DiD) design. In this quasi-experimental design, the difference in the health-related quality of life of people in the treatment and control groups is compared before (pre-treatment) and after the introduction of the intervention (post-treatment). Suppose the introduction of wind turbines in the residential environment has an effect. In that case, there is a difference in wellbeing between the treatment and control groups after the introduction of the intervention, which differs from the difference between the control and treatment groups before the introduction of wind turbines in the residential environment.

The DiD estimator δ can be summarised as follows:

$$\delta = (y_{T_1} - y_{C_1}) - (y_{T_0} - y_{C_0}) \qquad (1)$$

with y_{T_1} the wellbeing of treatment group T after the intervention (t_1), y_{T_0} the wellbeing of treatment group T before the intervention (t_0), y_{C_1} the wellbeing of the control group C after the intervention and y_{C_0} the wellbeing of control group C before the intervention.

The design requires that the treatment and control groups differ only in the treatment. Some of our analytical samples have statistically significant differences regarding the local area characteristics (mostly at smaller radii), however. We, therefore, use the propensity score matching method, matching treatment and control subjects based on the observed characteristics at time t_0 (i.e., before treatment). The covariates were selected to explain differences in health-related quality of life between the treatment and control groups and do not influence the probability that a wind turbine will be built within a 6 km radius. As individual-level controls, we use sex, age group, whether the respondent had any overnight stays at the hospital in the previous calendar year, and the number of doctoral appointments attended in the three calendar months preceding the interview at the last wave. As area-level controls, we use the degree of rurality, whether the respondent lives in a residential area, and the proportion of the area (at municipality scale) used for road traffic. We use the statistical analysis software Stata v18 for the analysis. Propensity score matching is implemented as 1:1 nearest neighbour matching using the psmatch2 command. Balance on covariates is assessed using Rubin's B (the absolute standardised difference of the means of the linear index of the propensity score in the treated and (matched) non-treated group) and Rubin's R (the ratio of treated to (matched) non-treated variances of the propensity score index). Rubin (2001) recommends that B be less than 25 and that R be between 0.5 and 2 for the samples to be considered sufficiently balanced. Except when the treatment is wind turbines with at least 100 m hub height in a 2 km radius, all matched samples are balanced on covariates (see **Appendix 14** (A5-2)).

For estimation, we use a linear model and the fixed effects estimator. Regression equation (2) is as follows:

$$y_{it} = \alpha_i + \lambda_t + \beta_1 WT_{it} + \varepsilon_{it} \qquad (2)$$

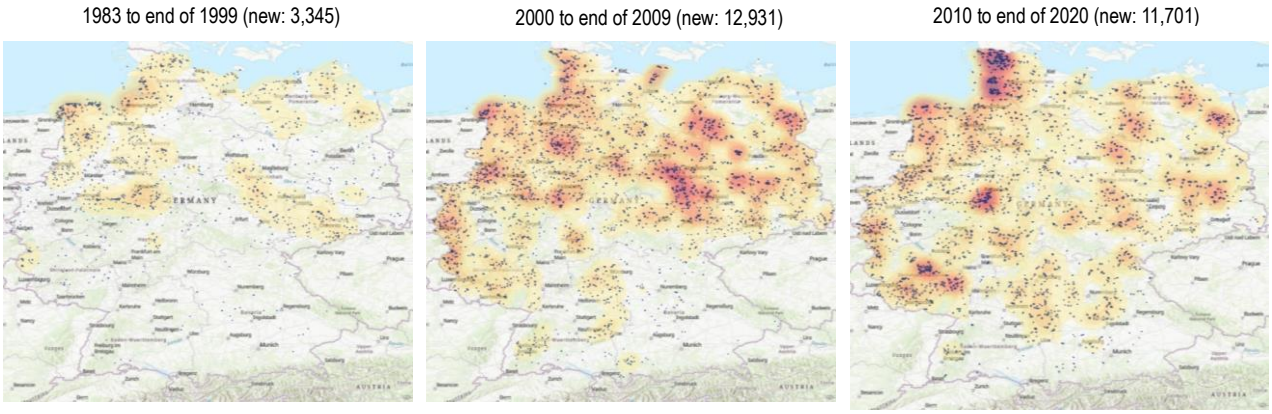
where y is the health-related quality of life of respondent *i* at survey time *t*, α_i captures all time-invariant individual traits (i.e., the individual fixed effect), and λ_t is the period effect. β_1 is the difference-in-differences (average treatment) effect, and ε is the idiosyncratic error term. Note that we focus our analysis on individuals who did not move houses between t_0 and t_1; hence, α_i also captures any neighbourhood fixed effects (such as the relatively stable distances to local amenities such as hospitals). WT_{it} is a dummy variable that takes the value 1 in period t if a wind turbine is present within the treatment radius r around the household of individual i , else nought.

In further specifications, we consider measures of the intensity of the treatment. For this, we multiply the treatment dummy by a) the number of installed wind turbines and b) the inverse distance to the closest installed wind turbine in the respective treatment radius.

5.3. Results

Figure 5-2 illustrates the expansion of wind turbines in Germany from 1983 to the end of 2020 using kernel density plots. The black spots in the map represent the exact location of wind turbines present at any time during the depicted period; the heat map indicates where more wind turbines have been built compared to the respective previous period.

Figure 5-2: Expansion of wind turbines in Germany from 1983 to end of 2020

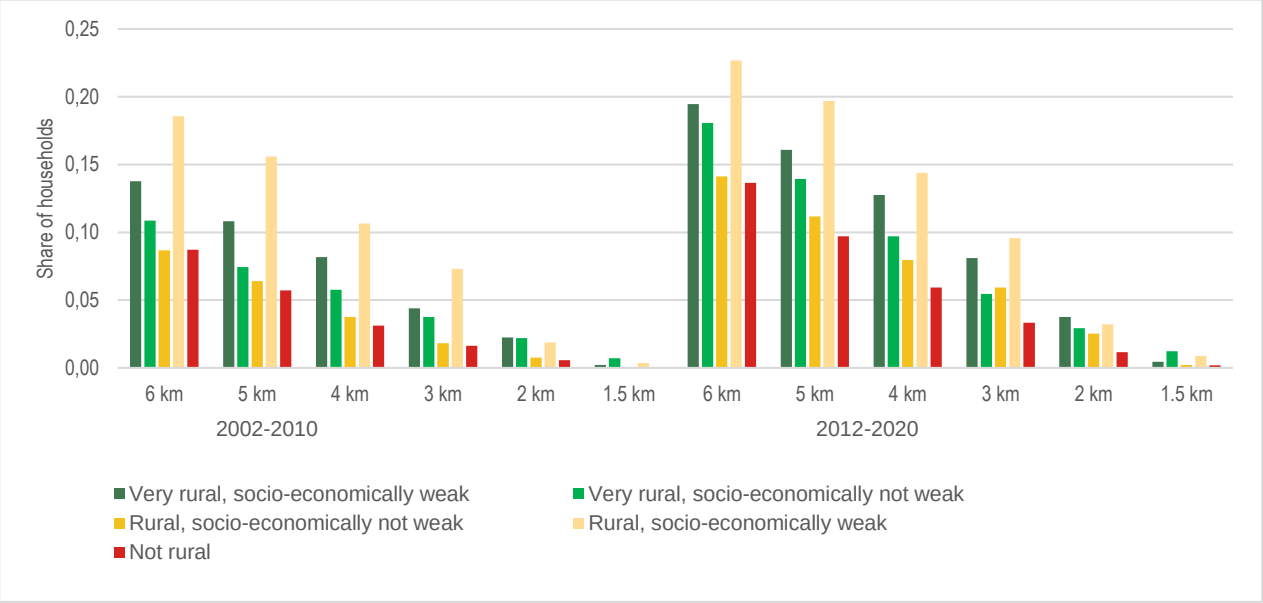


Source: Core Energy Market Data Register (MaStR, version of 31.03.2023) with own corrections.

The first 3,345 onshore wind turbines were constructed between 1983 and 1999, predominantly along the shorelines and within the federal states of Lower Saxony, Schleswig-Holstein, and Mecklenburg-Vorpommern in northern Germany. The second wave of onshore wind turbine construction, in the period 2000 to 2009, saw the construction of 12,931 wind turbines, this time spreading out into the interior of the aforementioned states as well as the Eastern German states of Thuringia and Saxony-Anhalt**.** In the third period of wind turbine construction, from 2010 to 2020, a total of 11,701 new wind turbines were constructed across all German states (except Berlin), with the regional focus being in Hesse and Rhineland-Palatinate, in the South West of Germany.

Figure 5-3 presents the proportion of households located within 6 km to 1.5 km of a wind turbine for two periods—2002–2010 and 2012–2020—disaggregated using the Thünen typology of rural areas. The Thünen Typology of Rural Areas is a classification system developed by the Thünen Institute to distinguish regions in Germany based on their degree of rurality and socio-economic characteristics. It categorises counties and county-regions (similar to NUTS 3 regions) according to factors such as population density, settlement structure, and economic performance (e.g., employment and income levels). The typology includes four main rural area types, and a fifth category, not rural, captures more urbanised regions.

Figure 5-3: Share of households located within 6 km of wind turbines in Germany 2002-2020, by type of rural area



Notes: Population estimates using the cross-sectional household population weights provided in SOEP.
Source: SOEP (v39) linked with Core Energy Market Data Register (MaSTR, version of April 1, 2023, with own corrections).

The results show a clear trend: the proportion of households living near wind turbines increased across all area types over time, including in non-rural areas. In the 2002–2010 period, 19% of households in socio-economically weak rural regions had at least one wind turbine within 6 km of their residence. This figure rose to 23% in the 2012–2020 period. A similar pattern was observed in very rural, socio-economically weak areas, where the share increased from 14% to 19%. In socio-economically not weak rural areas, proximity also grew significantly—from 11% of households in 2002–2010 to 19% in 2012–2020. These trends indicate that wind turbine development is not limited to remote or disadvantaged rural areas. Notably, even in non-rural areas and rural areas with stronger socio-economic profiles, exposure to wind turbines has risen. In these areas, the share of households within 6 km of a wind turbine grew from 9% to 14% over the two periods. Contrary to the common perception that wind turbine placement predominantly affects very rural and socio-economically weaker regions, the data reveal that wind turbine presence has expanded across the rural–urban spectrum.

Table 5-2 presents the results of standard fixed effects regression of HRQoL on the presence of wind turbines using the whole SOEP sample (i.e., without identifying treatment and control cases and matching them on observables in t_0). These models control for unobserved time-invariant individual characteristics but do not consider any aspects that change over time and that might (a) affect health-related quality of life and (b) be correlated with the introduction (or growth) of wind turbines. The sample is also not restricted to non-movers (thus not accounting for unobserved time-invariant place factors) or people who participated more than once in the panel study (thus, individual fixed effects are not accounted for).

Table 5-2: Fixed effects regressions of health-related quality of life (SF-12) on the presence of wind turbines in a radius of 1 km to 6 km of residential homes, 2002-2022

Any wind turbine	Mental health (MCS)				Physical health (PCS)				N
	β-coef.		SE	p-value	β-coef.		SE	p-value	
6 km	0.043		0.151	0.775	-1.468	***	0.123	0.000	209273
5 km	-0.012		0.173	0.945	-1.579	***	0.138	0.000	209273
4 km	-0.130		0.187	0.486	-1.703	***	0.158	0.000	209273
3 km	-0.190		0.243	0.435	-1.771	***	0.199	0.000	209273
2 km	-0.349		0.348	0.316	-1.673	***	0.273	0.000	209273
1 km	0.348		0.922	0.705	-1.527	***	0.590	0.010	209273
GE 500kW capacity									
6 km	-0.009		0.156	0.954	-1.479	***	0.127	0.000	209273
5 km	-0.060		0.179	0.740	-1.560	***	0.145	0.000	209273
4 km	-0.155		0.197	0.433	-1.664	***	0.167	0.000	209273
3 km	-0.160		0.254	0.529	-1.665	***	0.209	0.000	209273
2 km	-0.349		0.364	0.338	-1.627	***	0.293	0.000	209273
1 km	0.022		0.966	0.982	-1.691	***	0.616	0.006	209273
Hub GE 50m									
6 km	-0.013		0.161	0.934	-1.449	***	0.130	0.000	209273
5 km	-0.095		0.182	0.603	-1.567	***	0.146	0.000	209273
4 km	-0.198		0.201	0.325	-1.698	***	0.170	0.000	209273
3 km	-0.193		0.258	0.455	-1.732	***	0.212	0.000	209273
2 km	-0.379		0.370	0.306	-1.750	***	0.294	0.000	209273
1 km	-0.037		1.037	0.972	-1.934	***	0.635	0.002	209273
Hub GE 100m									
6 km	0.103		0.182	0.573	-1.989	***	0.150	0.000	209273
5 km	0.128		0.215	0.551	-2.020	***	0.179	0.000	209273
4 km	0.092		0.261	0.725	-2.135	***	0.216	0.000	209273
3 km	0.093		0.351	0.792	-2.309	***	0.266	0.000	209273
2 km	0.008		0.556	0.988	-2.338	***	0.401	0.000	209273
1 km	0.857		1.379	0.534	-2.559	***	0.804	0.001	209273

Notes: Robust standard errors. Statistical significance at 95%-level: * p<0.05, ** p<0.005, *** p<0.001. See **Appendix 15** (A5-3) for additional results on associations with the number of wind turbines and with the inverse distance to wind turbines. Results with additional socio-economic controls are also reported.

Source: SOEP (v39) linked with Core Energy Market Data Register (MaSTR, version of April 1, 2023, with own corrections).

We present findings on both components of health-related quality of life (HRQoL). For the mental health component, we found no statistically significant differences in Mental Component Summary (MCS) scores between individuals living near wind turbines and those who do not. Although the coefficients suggest a negative association across all groups of wind turbines—whether considering any wind turbines or larger ones with at least 500 kW capacity and varying hub heights (>=50 m and >=100 m)—these associations do not reach conventional levels of statistical significance. In contrast, all associations between physical HRQoL (PCS) and wind turbines within radii ranging from 1 km to 6 km are negative and statistically significant. We observe a general trend of increasing negative associations as the radius is tightened. The size of the coefficients increases slightly when excluding the smallest wind turbines, which are typically located closer to homes.

In Table 5-3, we present the findings from more rigorous difference-in-differences fixed effects panel estimations conducted on matched samples of non-movers. These samples include individuals who experienced the

construction of a wind turbine within a specified radius around their residences (treatment group) and those who did not encounter such construction but had a wind turbine located between 10 km and 15 km from their home (control group). The analysis compares two measurement occasions of health-related quality of life (HRQoL).

Table 5-3: Fixed effects difference-in-differences panel regressions of health-related quality of life (SF-12) on the presence of wind turbines in a radius of 1.5 km to 6 km of residential homes (quasi-experimental sample)

Any wind turbines	Mental health (MCS)				Physical health (PCS)				
	β-coef.		SE	p-value	β-coef.		SE	p-value	N
6 km	0.216		0.626	0.730	0.531		0.491	0.279	1764
5 km	-0.187		0.750	0.803	0.504		0.600	0.401	1164
4 km	0.007		0.929	0.994	0.669		0.747	0.371	792
3 km	-0.555		1.421	0.697	2.243		1.261	0.077	316
2 km	1.455		2.034	0.477	2.783		1.782	0.123	128
1.5 km	1.047		2.294	0.651	0.611		2.284	0.791	76
GE 500kW capacity									
6 km	0.227		0.634	0.721	-0.043		0.495	0.930	1724
5 km	0.185		0.751	0.805	-0.194		0.606	0.749	1124
4 km	0.028		0.937	0.976	0.054		0.745	0.942	756
3 km	-0.349		1.382	0.801	0.645		1.104	0.560	328
2 km	-1.680		2.074	0.421	2.374		1.766	0.184	124
1.5 km	0.429		2.603	0.870	-0.097		2.317	0.967	72
hub GE 50m									
6 km	-0.066		0.650	0.919	0.673		0.499	0.178	1692
5 km	-0.576		0.784	0.463	0.357		0.604	0.555	1124
4 km	-0.450		0.965	0.641	0.678		0.702	0.335	780
3 km	-2.443		1.394	0.082	2.299	*	1.129	0.043	328
2 km	-2.840		2.078	0.177	3.577	*	1.772	0.048	128
1.5 km	-0.622		2.368	0.794	0.253		2.238	0.911	76
hub GE 100m									
6 km	-0.227		0.518	0.672	0.896	*	0.405	0.027	2668
5 km	0.345		0.653	0.815	0.524		0.494	0.289	1756
4 km	-0.140		0.793	0.798	0.378		0.638	0.554	1076
3 km	-0.857		1.125	0.633	0.398		0.976	0.684	516
2 km	-1.632		1.879	0.493	2.966		2.198	0.183	112
1.5 km	-0.559		3.655	0.860	-4.916		4.732	0.315	32

Notes: Robust standard errors. Statistical significance at 95%-level: * p<0.05, ** p<0.005, *** p<0.001. See **Appendix 16** (A5-4).
Source: SOEP (v39) linked with Core Energy Market Data Register (MaSTR, version of April 1, 2023, with own corrections).

The results for the quasi-experimental sample generally indicate that there are no statistically significant associations between the presence of wind turbines within a 6 km radius of individuals' residences and their physical or mental HRQoL. However, we find several statistically significant associations when focusing on larger wind turbines. Specifically, individuals living within a radius of 2 km and 3 km of wind turbines with a hub height of at least 50 m have, on average, increased their physical HRQoL (+3.577, p<0.05, and +2.299, p<0.05, respectively) compared to the control group. Additionally, for individuals near turbines with a hub height of at least 100 m within 6 km, the mean difference in the PCS amounts to +0.896 (p<0.05). The latter two improvements in mean PSC scores in the treatment

group compared to the control group are robust to the inclusion of a range of individual and area-level controls (+0.9, p<0.05, and +2.550, p<0.05, respectively), see **Appendix 15** (A5-3).

Table 5-4: Fixed effects difference-in-differences panel regressions of health-related quality of life (SF-12) on number of wind turbines (quasi-experimental sample)

All wind turbines	Mental health (MCS)				Physical health (PCS)				N
	β-coef.		SE	p-value	β-coef.		SE	p-value	
6 km	-0.133		0.216	0.539	0.077		0.205	0.707	1764
5 km	-0.341		0.261	0.191	0.121		0.269	0.654	1164
4 km	-0.609		0.314	0.053	0.266		0.344	0.440	792
3 km	-0.817	*	0.331	0.015	0.334		0.487	0.494	316
2 km	0.800		1.981	0.688	2.388		1.648	0.152	128
1.5 km	1.047		2.294	0.651	0.611		2.284	0.791	76
GE 500kW capacity									
6 km	-0.142		0.209	0.498	-0.032		0.188	0.865	1724
5 km	-0.281		0.259	0.279	-0.009		0.260	0.973	1124
4 km	-0.654	*	0.315	0.038	0.115		0.331	0.728	756
3 km	-0.739	*	0.324	0.024	0.026		0.429	0.953	328
2 km	-1.950		1.877	0.303	1.974		1.625	0.229	124
1.5 km	0.429		2.603	0.870	-0.097		2.317	0.967	72
hub GE 50m									
6 km	-0.166		0.208	0.425	0.121		0.197	0.538	1692
5 km	-0.430		0.258	0.096	0.145		0.258	0.575	1124
4 km	-0.667	*	0.307	0.030	0.314		0.315	0.320	780
3 km	-1.161	**	0.350	0.001	0.359		0.478	0.453	328
2 km	-3.015		1.873	0.112	3.094		1.659	0.067	128
1.5 km	-0.622		2.368	0.794	0.253		2.238	0.911	76
hub GE 100m									
6 km	0.052		0.088	0.554	0.080		0.062	0.197	2668
5 km	0.121		0.094	0.199	0.051		0.067	0.447	1756
4 km	0.217		0.136	0.112	0.051		0.115	0.658	1076
3 km	0.150		0.215	0.487	0.088		0.149	0.555	516
2 km	-0.814		0.818	0.324	1.487		1.006	0.145	112
1.5 km	-0.559		3.655	0.881	-4.916		4.732	0.315	32

Notes: Robust standard errors. Statistical significance at 95%-level: * p<0.05, ** p<0.005, *** p<0.001. See **Appendix 16** (A5-4).
Source: SOEP (v39) linked with Core Energy Market Data Register (MaSTR, version of April 1, 2023, with own corrections).

Wind turbines, particularly the larger ones operated by commercial providers, are often put up in wind farms. This can also be observed in our quasi-experimental samples.[32] The experience of having many large wind turbines placed in one's neighbourhood may be more stressful than having one small wind turbine put up. Thus, rather than just examining whether the presence of a wind turbine matters for HRQoL, next we check whether the number of wind turbines matters, see Table 5-4. We find empirical support for the hypothesis that the intensity of treatment matters in some of our samples. Regarding mental health, the results suggest that each additional wind turbine within a radius of 3 km is associated with a reduction of -0.817 (p<0.05) in the MCS; if the wind turbine has a hub

32 The individuals in our treatment samples had between 1 and 16 (Mean: 1.8) wind turbines built within 6 km of their home; for the largest wind turbines (hub heights of at least 100 m), the respective average amounts to 2.876, see Appendix 5-1.

height of at least 50 m, the reduction is more marked, amounting to -1.161 (p<0.01). Within 4 km, wind turbines with 500 kW or more are associated with a -0.654 (p<0.05) in MCS; for wind turbines >= 50m, the effect is in the same ballpark (-0.667, p<0.05). Wind turbines do not impact physical health.

Table 5-5: Fixed effects DiD panel regressions of health-related quality of life (SF-12) on inverse distance to wind turbines (quasi-experimental sample)

All wind turbines	Mental health (MCS)				Physical health (PCS)				N
	β-coef.		SE	p-value	β-coef.		SE	p-value	
6 km	-0.013		0.015	0.367	-0.010		0.011	0.399	1764
5 km	-0.003		0.021	0.886	-0.012		0.017	0.476	1164
4 km	-0.007		0.031	0.818	-0.013		0.025	0.613	792
3 km	0.014		0.068	0.837	-0.109		0.058	0.061	316
2 km	-0.114		0.147	0.442	-0.192		0.115	0.100	128
1.5 km	-0.117		0.182	0.523	0.002		0.192	0.993	76
GE 500kW capacity									
6 km	-0.014		0.015	0.354	0.002		0.011	0.866	1724
5 km	-0.016		0.021	0.442	0.009		0.017	0.584	1124
4 km	-0.018		0.032	0.559	0.009		0.025	0.711	756
3 km	-0.010		0.067	0.883	-0.034		0.052	0.517	328
2 km	0.174		0.147	0.239	-0.174		0.114	0.131	124
1.5 km	-0.070		0.205	0.733	0.062		0.192	0.750	72
hub GE 50m									
6 km	-0.005		0.015	0.720	-0.014		0.011	0.210	1692
5 km	0.004		0.022	0.868	-0.005		0.018	0.760	1124
4 km	-0.004		0.032	0.894	-0.011		0.024	0.643	780
3 km	0.079		0.067	0.245	-0.104		0.053	0.051	328
2 km	0.252		0.147	0.092	-0.253	*	0.115	0.032	128
1.5 km	0.017		0.189	0.928	0.030		0.188	0.873	76
hub GE 100m									
6 km	-0.001		0.012	0.914	-0.020	*	0.010	0.035	2668
5 km	-0.027		0.020	0.170	-0.015		0.014	0.287	1756
4 km	-0.013		0.029	0.654	-0.014		0.022	0.532	1076
3 km	0.024		0.051	0.632	-0.013		0.045	0.776	516
2 km	0.116		0.115	0.321	-0.218		0.134	0.110	112
1.5 km	0.040		0.272	0.886	0.360		0.352	0.323	32

Notes: Robust standard errors. Statistical significance at 95%-level: * p<0.05, ** p<0.005, *** p<0.001. See Appendix 16 (A5-4).
Source: SOEP (v39) linked with Core Energy Market Data Register (MaSTR, version of April 1, 2023, with own corrections).

Last but not least, we examine whether the proximity to wind turbines matters for HRQoL. The results, presented in Table 5-5, suggest that greater proximity to wind turbines is associated with reductions in HRQoL – the majority of the coefficients are negative – but only the effects on physical HRQoL of distances to wind turbines with at least 50 m hub height in a radius of 2 km (-0.253, p<0.05) and wind turbines with at least 100m hub height in a radius of 6 km (-0.020, p<0.05) reach conventional levels of statistical significance.

5.4. Discussion

Our analysis yields a nuanced picture of how wind turbines relate to health-related quality of life (HRQoL). The standard fixed effects regressions on the full SOEP sample (Table 5-2) suggest that, while mental HRQoL (MCS) shows no systematic relationship with proximity to wind turbines, physical HRQoL (PCS) declines significantly among individuals living closer to turbines—an effect that intensifies as the radius is tightened and when smaller turbines are excluded. This pattern is consistent with prior cross-sectional findings linking wind turbine proximity to sleep disturbance, annoyance, and somatic complaints (Shepherd, McBride et al. 2011, Bakker, Pedersen et al. 2012), which may manifest as reduced physical wellbeing even if mental health remains unaffected.

However, when leveraging the quasi-experimental, difference-in-differences design on matched non-movers (Table 5-3), we observed no adverse effects on either HRQoL component for turbines within a 6 km radius. Intriguingly, larger turbines (hub height ≥ 50 m and ≥ 100 m) are associated with modest improvements in physical HRQoL (+3.58 PCS points at 2 km; +2.30 at 3 km; +0.90 at 6 km), all statistically significant at $p < 0.05$. One plausible interpretation is that larger, commercially operated turbines are often erected as part of wind farms, which may bring local economic benefits—such as employment opportunities, enhanced infrastructure, or community funds (Gavard, Göbel and Schoch 2025)—that offset any direct nuisances and translate into perceived physical wellbeing gains.

Our intensity analyses (Table 5-4) further refine this story by showing that the number of turbines within 3–4 km is negatively associated with mental HRQoL: each additional turbine reduces MCS by 0.65–1.16 points, depending on turbine size. This finding implies that cumulative exposure may exacerbate annoyance or stress even if proximity alone or a single new turbine does not. Notably, physical HRQoL remains unaffected by turbine count, indicating that the mechanisms through which turbine density influences wellbeing are primarily psychological or perceptual.

Finally, examining inverse distance measures (Table 5-5) confirms that closer proximity to larger turbines can modestly depress physical HRQoL (−0.253 PCS points per 1/distance unit for ≥ 50 m turbines within 2 km; −0.020 for ≥ 100 m turbines within 6 km). These small but statistically significant effects underscore that even in our more rigorous designs, some detrimental impacts on physical wellbeing persist, particularly for the tallest turbines.

How large are these negative effects on mental health? Cleland, Kearns et al. (2016) reported several statistically significant associations between HRQoL and various life events. Specifically, MCS is reduced by a relationship breakdown (−7.3), a health event (−6.0), being the victim of a crime (−5.4), bereavement (−2.3) and a house move (−2.1). MCS is increased by a new job/promotion (+4.9) and parenthood (+3.6).

Key messages

- **Component-specific effects:** Physical and mental HRQoL respond differently to turbine exposure. While physical wellbeing appears most sensitive to proximity and turbine size, mental wellbeing is influenced by overall turbine density.
- **Importance of research design:** Effects apparent in uncontrolled fixed effects models can attenuate or reverse when leveraging quasi-experimental matching, suggesting that unobserved confounders (e.g., pre-existing neighbourhood amenities or individual health trends) may bias simpler specifications.
- **Heterogeneity by turbine characteristics:** Larger turbines—often sited in commercial wind farms—may confer indirect benefits that improve physical HRQoL, even as increased density heightens mental strain.

Despite the strengths of panel fixed effects and matched quasi-experimental designs, several limitations warrant caution. First, our models cannot entirely rule out time-varying confounders (e.g., evolving local labour markets or concurrent infrastructure developments) that correlate with turbine installation. Second, restricting the quasi-experimental sample to non-movers may limit generalisability to more mobile populations. However, from this perspective, our results may be regarded as lower-bound estimates, as those most affected by wind turbines will

likely move to areas without wind turbines. Third, HRQoL measures, while validated, may not capture specific wind turbine–related annoyances (e.g., shadow flicker, infrasound perception), suggesting the value of incorporating specialised noise and annoyance metrics. Finally, the average follow-up duration between pre- and post-installation HRQoL measures may be too short to observe long-term adaptation or chronic health impacts.

Future studies should aim to integrate objective noise measurements – possibly by adding further wind turbine type-specific information from providers - and longitudinal follow-up over extended periods, as well as broader wellbeing indicators (e.g., community cohesion, economic satisfaction). Qualitative research exploring residents' subjective experiences could also illuminate the pathways linking turbine exposure to components of HRQoL. Framing this research neutrally – i.e., without biasing participants in a particular direction - and recruiting neutral participants - i.e., those who are not already determined wind energy supporters or opponents - is challenging in areas already earmarked for wind energy.

Germany represents a unique case for analysing the wellbeing impacts of wind turbine exposure, owing to the combination of a comprehensive, open-access wind turbine register with precise coordinates and installation dates and the availability of detailed, geocoded longitudinal survey data from the SOEP. Replicating such research in other European countries remains challenging. While several countries maintain national databases of wind turbine locations—such as France with the Base OREOL (Ministry for the Ecological Transition and Territorial Cohesion 2025) and Sweden with the Vindbrukskollen (Länsstyrelserna gemensamt 2025)—few possess long-running, large-scale panel datasets with georeferenced residential information and subjective wellbeing measures that would allow for comparable micro-level linkage. The United Kingdom offers high-quality longitudinal data through Understanding Society *and* wind turbine information via the Renewable Energy Planning Database (Department for Energy Security and Net Zero 2025). However, both data sources are less granular than their German counterparts: the wind turbine datasets lack exact installation dates and individual turbine coordinates, and the panel study does not provide precise residential geocodes for research use.[33] Moreover, strict planning regulations have thus far resulted in relatively low residential exposure to onshore wind turbines in the UK, limiting statistical power to detect wellbeing effects. Consequently, Germany remains a uniquely data-rich context for studying the causal impacts of renewable energy infrastructure on subjective wellbeing. While the German data exploited here is unique, findings may be generalisable because the underlying mechanisms linking wind turbine exposure to wellbeing—such as visual, acoustic, and social perceptions of renewable infrastructure—are not unique to Germany. Similar planning frameworks, settlement patterns, and attitudes toward wind energy exist across much of Europe. Moreover, the analytical design, which exploits within-individual variation and controls for both personal and neighbourhood fixed effects, identifies causal pathways likely to operate similarly in other contexts. While contextual differences in regulation, turbine density, and community engagement may affect the magnitude of effects, the fundamental processes underlying the German results are expected to extend to other European settings.

5.5. Conclusions

This study leverages a large, nationally representative panel and quasi-experimental matching to untangle the complex relationships between wind turbine exposure and HRQoL. While simple fixed-effects analyses suggest that proximity to turbines diminishes physical wellbeing, rigorous difference-in-differences estimations reveal that larger turbines may paradoxically enhance physical HRQoL—potentially via community benefits—though higher turbine density consistently undermines mental health. These findings highlight the need for strategies that reduce clustering of wind turbines near residences, integrate community benefit schemes, and proactively address any noise and visual impact concerns local residents may have. Policymakers and developers should also consider the mental health and wellbeing of the local population, not only physical health impacts and impacts on objective wellbeing metrics. It is important to ensure that renewable energy goals align with the subjective wellbeing of local populations. Future work that harnesses objective environmental data, incorporates longer follow-up periods, and utilises granular annoyance measures will be crucial to elucidate the health implications of wind power deployment fully.

[33] In secure data settings, only the coordinates of postcode centroids—not individual addresses—are available for analysis. Because postcode areas are much larger in rural areas than in urban ones, where a postcode may correspond to a single dwelling, distance-based measures of exposure are considerably less precise in rural contexts.

6. Overall conclusions

This report has sought to advance understanding of subjective wellbeing (SWB) across rural (and urban) Europe, combining systematic review, conceptual extension, and novel empirical analysis. The findings collectively confirm that rural contexts often foster wellbeing advantages, but these are not uniform, nor are they guaranteed. They depend on how "rurality" is defined, which wellbeing dimensions are considered, and which contextual features are taken into account.

Across the chapters, several consistent themes emerge:

- **Rural advantage in subjective wellbeing exists, but is heterogeneous.** Life satisfaction is, on average, higher in rural areas, yet advantages in affective wellbeing and basic psychological needs are less robust. Social wellbeing and mental resources (e.g., resilience) are the most consistently higher among rural residents.
- **Measurement matters.** Studies using self-reported settlement type reveal stronger rural advantages than those using administrative or density-based classifications. This highlights the need for greater precision and transparency in defining "rural" and "urban."
- **Contextual conditions are critical.** Area deprivation consistently erodes life satisfaction, particularly in urban areas. Local service access, environmental quality, and neighbourhood composition moderate wellbeing outcomes, demonstrating that rural advantages cannot be reduced to population density alone.
- **Environmental trade-offs are complex.** Wind turbines exemplify the nuanced relationship between rural development and wellbeing. While simple models suggest that proximity harms physical health, quasi-experimental evidence indicates potential wellbeing gains from larger turbines, linked to community benefits, alongside mental health costs associated with high turbine density.

Taken together, these results underscore that rural wellbeing cannot be understood in isolation from context. The "rural advantage" is real but contingent—shaped by social ties, mental resources, service access, environmental quality, and the ways rural development is planned and implemented.

Policy lessons:

- Rural policies should explicitly incorporate subjective wellbeing alongside economic indicators, recognising the multidimensional nature of quality of life.
- Fine-grained measurement and monitoring are essential—moving beyond simple rural–urban divides to capture the diversity of rural contexts.
- Investment in local services, reducing deprivation, and strengthening social cohesion can reinforce rural wellbeing advantages.
- Renewable energy and other rural developments should be pursued with community engagement and benefit-sharing mechanisms to align environmental goals with residents' quality of life.

Future research priorities:

- Broaden geographic coverage, particularly in underrepresented regions of Europe.
- Standardise measurement instruments, integrating evaluative and affective dimensions of wellbeing.
- Exploit longitudinal and geocoded data to unpack causal mechanisms and track change over time.
- Link wellbeing outcomes more directly to policy interventions to assess their real-world impact.

In conclusion, the report affirms the importance of rural contexts for wellbeing while highlighting the complexity of the pathways involved. By deepening our understanding of these dynamics, policymakers and researchers can better support thriving rural communities and ensure that the pursuit of economic, social, and environmental goals is grounded in the lived experiences of Europe's citizens.

7. Acknowledgements

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9. Appendix

Appendices list (Excel workbook):

- **Appendix 1 (A2-1):** List of publications included in the systematic review of rural area effects on subjective wellbeing and rural subjective wellbeing advantage in Europe in the empirical literature 2000-2023
- **Appendix 2 (A2-2):** Rural area effects on subjective wellbeing and rural subjective wellbeing advantage in Europe in the empirical literature 2000-2023
- **Appendix 3 (A2-3):** Rural area effects on subjective wellbeing and rural subjective wellbeing advantage in Europe in the empirical literature 2000-2023: Rural-urban classifications by geographical scale
- **Appendix 4 (A3-1):** Descriptive statistics of analytical sample - whole sample followed by welfare state group- and country-specific statistics
- **Appendix 5 (A3-2):** Population estimates - all countries followed by welfare state group- and country-specific statistics
- **Appendix 6 (A3-3):** Average subjective wellbeing scores (MPI)
- **Appendix 7 (A3-4):** Average subjective wellbeing scores (MPI) by settlement type
- **Appendix 8 (A3-5_*):** Multivariate regressions on life satisfaction (LS), Affective wellbeing (AW), Basic Psychological Needs Satisfaction (NS), Mental Resources (MR), Social wellbeing (SW), and Evaluative wellbeing (EW).
- **Appendix 9 (A3-6_*):** Country-specific multivariate regressions on subjective wellbeing (UK, NL, PL, ES, FR, D1, D2, PT)
- **Appendix 10 (A4-1):** Descriptive statistics of all variables used in the empirical analysis
- **Appendix 11 (A4-2):** Random Effects Generalised Least Squares Regressions of life satisfaction on rurality, area and individual characteristics, GB 2009-2023
- **Appendix 12 (A4-3):** Random Effects Generalised Least Squares Regressions of life satisfaction on area and individual characteristics by rurality, GB 2009-2023
- **Appendix 13 (A5-1):** Description of analytical samples used in wind turbine analysis
- **Appendix 14 (A5-2):** Propensity score matching statistics for all treatment groups
- **Appendix 15 (A5-3):** Fixed effects regressions of SF12 (MCS and PCS) on the presence of wind turbines, the number of wind turbines, and the inverse distance to wind turbines in a radius of 1 km to 6 km of residential homes. Germany 2002-2022
- **Appendix 16 (A5-4):** Fixed effects difference-in-differences regressions of SF-12 (MCS and PCS) on the presence of wind turbines, the number of wind turbines, and the inverse distance to wind turbines within a radius of 1 km to 6 km of residential homes. Germany 2002-2022