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Housing Conditions and the Quality of Life of the Populations of the European Union Countries

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Abstract: Quality of life (QoL) as a category, which is an overarching goal of sustainable development, dependent on many factors both objective and subjective, should be subjected to constant monitoring in various spatial, temporal and thematic arrangements. This study assesses the spatial differentiation of European Union countries in terms of QoL and housing conditions (HCs) of their populations. Interactions between the studied phenomena were also determined. A multi-criteria decision-making (MCDM) method—the TOPSIS method—and Spearman rank correlation coefficients were used to achieve the objectives of this study. The analysis was conducted using 2019 and 2022 data from the Eurostat database (including the EU-SILC survey) and TheGlobalEconomy.com. The research showed that the housing conditions and QoL of the populations of EU countries vary spatially, being more favorable in Austria, Ireland and Slovenia and the Scandinavian countries of Denmark, Finland and Sweden and less favorable in Greece and some of the countries that joined the EU in 2004 and in 2007, viz. Bulgaria, Hungary and Romania. This study noted a very strong positive correlation between the positions of countries in the rankings created with QoL in 2019 and 2022 (0.947) and with living conditions in the years under study (0.828), as well as a rather weak correlation between QoL and HCs in both 2019 (0.272) and 2022 (0.292). This article fills a research gap because, to our knowledge, the indicated phenomena have not been analyzed to date in the contexts presented in this article.

Keywords: housing conditions; quality of life; sustainability; TOPSIS method

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1. Introduction

Housing conditions (HCs) and their levels impact the ability to meet all human needs affecting the quality of life. Without housing that is characterized by an adequate standard, a dignified existence is not possible, and the individual has no chance to realize their social and economic rights and obligations to ensure the proper quality of life of the population (QoL).

The purpose of the research undertaken was to assess the spatial variation in the European Union countries in terms of the QoL and HCs of their populations. The specific objectives of this study include assessing the direction of changes in QoL and HCs in 2022 in relation to 2019 and the interactions between the studied phenomena. The authors, when embarking on this study, formulated the following research question: does the interaction between QoL and HCs in the European Union have a synergistic nature? It was possible

to achieve the goal of the research by using a multi-criteria decision-making (MCDM) method—the TOPSIS method—and Spearman rank correlation coefficients. The research investigation was conducted using data from 2019 and 2022, which were obtained from the Eurostat database (including the EU-SILC survey) and TheGlobalEconomy.com.

Achieving the Sustainable Development Goals is expected to lead to sustainable improvements in the QoL of both present and future generations. Economic and social cohesion in the European Union requires identifying differences among member countries in order to bridge them. Analyses of the QoL of populations and its constituent components play an important role in reducing development disparities. This includes issues related to the quality of life of populations and housing conditions, which in this study is treated as a phenomenon of fundamental importance for QoL. The desire to identify the aforementioned differences between countries was the authors' motivation for the research problems undertaken. The innovative nature of the research is related to the adoption of a specific set of diagnostic variables for assessing the spatial differentiation of European Union countries in terms of HCs and QoL, in unidimensional and multidimensional terms, taking into account comparisons of phenomena over time.

This article is structured as follows: the introduction presents the authors' motivations and intentions, the objectives of this study, data sources and research methods. The second section contains a literature review covering the problems of QoL and its relationship with sustainability and HCs and their relevance to QoL. The third section is devoted to the research methods and data used. The fourth section comprehensively describes the research results. This article concludes with an extensive discussion.

2. Literature Review

2.1. Quality of Life—Definition and Relationship to Sustainable Development and Measurement

QoL appears in the theoretical discourses of representatives of many fields and scientific disciplines, which testifies to the complex, multifaceted nature of this concept. The issue of QoL arouses the interest of researchers working in pedagogy, psychology, economics, sociology, medicine and philosophy [1–12]. The controversy surrounding this issue also involves representatives representing the same fields of knowledge. Such a situation is mainly due to the focus of researchers on different aspects of QoL and the interdisciplinary nature of this concept [13]. On the one hand, this promotes the complementarity of different approaches and allows for a broad, interdisciplinary view, but on the other hand, it results in a diversity of interpretations of the term and a lack of consistency in its operationalization [14]. The resulting definitions are neither mutually exclusive nor inconsistent. They focus on different aspects, emphasize different areas of reality and are based on diverse grounds, although most often their common starting point are the following questions: How do people live? How do they evaluate their daily life? Are they satisfied with their situation? [15]. In any case, however, regardless of the scientific discipline represented by the researcher, this requires an awareness that there is a range of conceptualizations, terms and definitions, and that for any particular study, there must be consistency between the way the chosen term is defined and operationalized in a given context. This does not mean, therefore, that all researchers should accept the same definition [16]. The participation of Polish researchers in the study of QoL issues is significant, both in terms of conceptualization and operationalization (Table 1).

Table 1. Concept of QoL—selected definitions.

Defining Entity/Year	Definition of QoL
World Health Organization (WHO) 1947 [17]	A state of total physical, mental and social well-being, not just the absence of disease and infirmity.
World Health Organization (WHO) 1995 [18]	An individual's perception of their position in life in the context of the culture and value systems in which they live and, in relation to their goals, expectations, standards and concerns.
Ostasiewicz W. 2004 [19]	The quality of everything that defines human life, as well as the quantity of everything needed to live; the quality of life is not only represented by a good material existence, but also by a good state of mind, welfare and well-being.
Borys T. 2005 [20]	Balanced appreciation and perception of all the richness of global quality and the coexistence of well-being (qualities of the "have" type), prosperity (qualities of the "be" type) and bliss (qualities of the "love" type) in human life. In other words, the quality of a person's life means the balance of their physical, mental and spiritual (emotional) development.
Encyclopedia of Polish Scientific Publishers (PWN) [21]	The degree of satisfaction of material and non-material needs and meeting the standards or realizing the values—biological, psychological, spiritual, social and political, cultural, economic and ecological—of individuals, families and communities.
Piontek B. 2002 [22]	High quality of life should guarantee human development in all its dimensions by shaping the right proportions in the generation, satisfaction and realization of economic (including material), social, natural and spiritual needs, while preserving the criterion functions of the moral sphere.
Kolman R. 2000 [23]	The degree of satisfaction of spiritual and material needs of human beings, the degree of satisfaction of requirements determining the level of material and spiritual existence of individuals and society as a whole, and the degree of fulfillment of the expectations of contractual normality in the activities and situations of daily life of individuals and society.
Campbell A. 1981 [24]	QoL is a good life in the consumer sense, dependent on the status of individual material goods. It divides overall quality of life into thirteen domain qualities of life: material standard of living; health; education and personal development; family, social and neighborhood relations; housing; leisure and recreation; and employment and working conditions.
Sen A. 1995 [25]	The quality of life is in existence, not in the possession of goods. A person's well-being can be understood as their quality of life, and life is a set of "functioning", which can range from such elementary achievements as eating properly and enjoying good health to more complex achievements—being happy, feeling dignified, and participating in social life.
Berger-Schmitt R. and Noll H.-H. 2000 [26]	Advocate a broad concept of quality of life, which includes not only the objective living conditions and subjective well-being of individual citizens, but also the social characteristics highlighted by the concepts of social cohesion and sustainable development.

There are three concepts underlying the concept of QoL [19]: happiness, resources and needs. The origins of the approach in which happiness quantifies QoL are found in philosophical considerations. Within this approach, QoL is identified with the satisfaction people feel about their lives as a whole or particular areas of their lives. As a basis for evaluating QoL, Ostasiewicz [19] also proposes to accept the possibility of human beings using their possessions to live with dignity. He points out that it is more important to be able to possess a good or possibly enjoy it, than the good itself or to enjoy it. The most commonly accepted basis for the definition of QoL is the theory of needs. The economic literature defines a need as a state of lack of something and, at the same time, a factor that

triggers the motive function of action toward a corresponding change in this state [27]. A high degree of human need fulfillment is indicative of a high QoL. In research on quality of life, following Maslow's theory, it is assumed that there is a certain order of needs and values valued by people, and therefore some common concepts of QoL [28], although there are situations when people consciously give up the satisfaction of higher-order needs recognizing that the fulfillment of needs at a given level provides them with sufficient satisfaction and motivation to act.

Research conducted in various scientific disciplines consistently identifies several key factors that significantly influence QoL while simultaneously defining it. Fiddler [29] points out that QoL is determined by a set of determinants that affect a person's well-being, satisfaction and awareness of self-realization through the fulfillment of goals and tasks set for oneself at various stages of life. Among these determinants, researchers point to a wide variety of elements that co-create QoL, dividing them into tangible and intangible, as well as objective and subjective [30]. They point to their specific categories such as the following [31–36]:

- the state of the environment;
- wealth seen both in the material sense (goods in our possession) and in the immaterial sense (access to education and culture);
- health and security in the health dimension (threat to life), in terms of loss of property (crime and natural disasters) and in the economic sense (necessary financial resources and job security), emotional well-being and the fulfillment of personal ideals;
- a sense of rootedness in the local environment, interpersonal relations and participation in the life of the community, and influence on decisions concerning its collective and individual life.

The numerous approaches to defining the concept of QoL make it necessary to organize knowledge in terms of its definition. This has been achieved by Borys [37], who proposes a classification of this category according to the criteria presented in Figure 1.

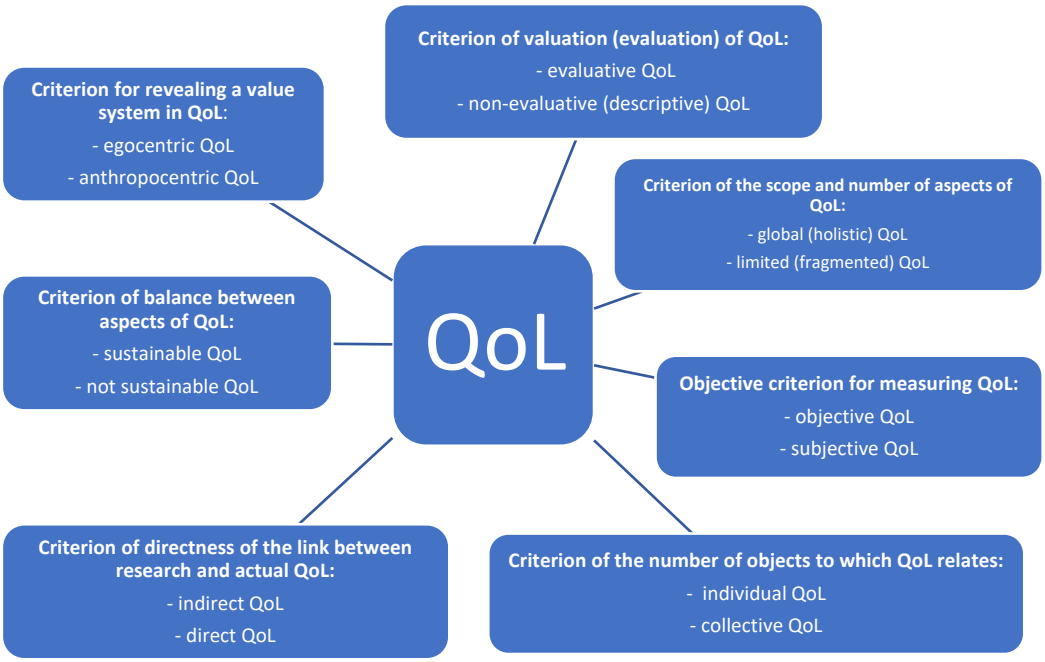

Figure 1. QoL classification criteria.

High QoL is the overarching goal of all policies, and consequently the overarching goal of the concept of sustainable development, with which it is inextricably linked [38].

The premise of sustainable development is the sustainable improvement in the QoL of present and future generations achieved by shaping the right balance in the management of three types of capital: economic, social and natural [22]. Improving QoL and reducing excessive disparities in its levels for different population groups (socially and spatially), including counteracting social exclusion and poverty, is a key objective of modern concepts of socioeconomic development [39], the implementation of which should take place at all levels of governance (international, national, regional and local). Sustainable improvement in QoL in the long term should be the main goal of public entities [40–42]. This is reflected in development strategies adopted at the global level (UN Agenda 2030), the European Union (Europe 2020—Strategy for smart, sustainable and inclusive growth, as well as strategies supporting the implementation of the UN Agenda 2030) and the national level (in Poland—Strategy for National Development 2020 and its update in the form of the Strategy for Responsible Development to 2020 with an Outlook to 2030). Improving QoL is also frequently on policymakers' agendas, and numerous studies have been conducted to assess QoL by governments, as well as European and global organizations [43,44]. Consequently, QoL measurement plays an important role in monitoring sustainable development. Detailed data on development parameters in three key dimensions—social, environmental and economic—are of interest not only to the scientific community, but also increasingly to local governments and local communities [45]. For years, there have been discussions internationally about why QoL should be measured and how to measure and analyze it [11]. Beginning in the second half of the 20th century, various attempts to measure QoL have been developed at the national and international levels [46]. The differences between these attempts mainly concern the dimensions of QoL considered, the indicators measured and, when the result is a synthetic indicator, the methodologies used to standardize and aggregate the various indicators [47,48].

As the experience of the European Union, individual countries and local governments [49] shows, QoL should be measured on the basis of two sets of indicators: sustainability indicators, i.e., objective data versus subjective data collected through surveys. Szukiełojć-Bieńkuńska [11] determined that the measurement should include both broadly defined living conditions (also referred to as "objective conditions" or "objective reality") and subjective well-being (subjective well-being). The author emphasizes that within the framework of living conditions, broadly defined, eight domains (thematic areas) are taken into account: material living conditions, health, education, economic activity—work or other main occupation, leisure time and social relations, economic and physical security, quality of the state and basic rights (including how these rights are realized), infrastructure, and the environment. Measurement of subjective well-being (as a separate dimension, the ninth domain) should not only include perceived QoL, i.e., the satisfaction people derive from life, but also elements on perceived emotional states and the value system, sense of meaning and purpose in life. The author also proposes a comprehensive approach to measuring QoL, which should include [11] the following:

- definition (a multidimensional approach is necessary);
- the method of approach (the nature of the phenomena studied): objective and subjective, referring to two complementary aspects of reality, and quantitative and qualitative, requiring the selection of specific indicators;
- level of observation: micro (individuals and groups) and macro (communities, regions, countries, etc.);
- dynamics relating to changing external and internal conditions and trends, which can be of different nature, depending on the phenomenon (linear, non-linear, chaotic, etc.) and relationships between phenomena.

The broad debate on QoL has not led to the identification of a methodology that is generally considered superior to others. This is due to the individual contexts of analysis and the recognized multidimensionality of the QoL concept, which includes and must take into account both objective/quantitative and subjective/qualitative variables [50–52].

2.2. Housing Conditions—Concept and Importance for Quality of Life

One of humans' basic needs and the foundation of a decent life is to have housing. Maslow's theory of the hierarchy of needs emphasizes the need for shelter as the first and most important in the natural order of satisfying needs: physiological, safety, social, recognition and esteem, and self-actualization needs [53].

On average, a person spends about 80% of their life in housing, making it a key element of human existence. Housing not only satisfies basic biological needs and provides regeneration but is also a fundamental need from an individual's perspective. However, its role goes far beyond these functions—it influences family stability, shapes culture and lifestyles, and affects demographic trends. Finally, housing is a place that protects important social and national values. Thus, the housing situation of the country largely determines the fate of the nation [54]. Ownership of housing is therefore of fundamental importance not only for individual citizens or households, but also for society as a whole and the proper functioning of the state. The housing situation of citizens affects labor force participation, qualifications and mobility. There is consensus among many economic and sociological theories about the extraordinary importance of the housing sector in individual, social, economic and state life [55]. Housing is also a key household asset, and its condition and furnishings significantly reflect the income level, wealth and asset position of its owners [56]. The purchase and maintenance of this asset is usually the largest household investment.

The priority of housing is evidenced by the fact that the right to adequate housing has been enshrined in world declarations, European Union regulations, as well as in the laws of individual countries. The UN, in the 1948 Universal Declaration of Human Rights, states that everyone has the right to a standard of living adequate for the health and well-being of themselves and their family, including food, clothing, housing, medical care and necessary social services, and the right to insurance against unemployment, sickness, incapacity, widowhood, old age or loss of livelihood otherwise beyond their control [57]. The 1966 UN International Covenant on Economic, Social and Economic Rights stipulates that States Parties recognize the right of everyone to an adequate standard of living for themselves and their family, including food, clothing and housing, and to the continuous improvement in living conditions [58]. The Charter of Fundamental Rights of the European Union [59] states that "in order to combat social exclusion and poverty, the Union recognizes and respects the right to social and housing assistance to ensure, in accordance with the principles laid down by Community law and national laws and practices, a decent existence for all those who lack sufficient resources". In this context, the European Council in 2000 agreed on a list of common objectives for the EU's strategy to combat poverty and social exclusion. Two of these goals are related to housing, namely, "implementing strategies to ensure that all citizens have access to decent and hygienic HCs and the basic services necessary for normal life, taking into account local conditions (electricity, water, heating, etc.)" and implementing strategies to prevent life crises that can lead to social exclusion, such as debt, school exclusion and homelessness [60].

In addition to housing, attention should be paid to the issue of adequate HCs, which can also be considered a basic human need. The definition of HCs is given by S. Kaczmarek [61], pointing in this regard to three basic, interrelated elements: the apartment, the building and its surroundings. The metrics used to analyze the standard of an apartment are comparable to the parameters commonly used to assess HCs (floor space and number

of rooms in relation to the number of residents). In turn, the standard of a building's surroundings, which is most often a semi-public and public space, can be assessed by taking into account such aspects as the availability of services, the ability to meet the needs of residents, access to green areas, the type of development and the functional structure of areas adjacent to residential areas. On the other hand, the building itself acts as an intermediate space, combining private space (housing) and public space (neighborhood). Such parameters as age, number of floors, number of apartments, technical equipment, type of development and technical condition can be used to assess its standard. Adequate housing must provide more than four walls and a roof; it must provide security of tenure, affordability, accessibility, adequate location and cultural adequacy. In addition, it must provide adequate habitability; that is, it must guarantee physical safety or provide adequate space, as well as protection from cold, damp, heat, rain, wind and other health hazards [62]. Amenities necessary for health, such as secured drinking water, heating, lighting, energy for cooking, sanitation and washing facilities, food storage, waste disposal and land drainage must also be provided [63].

Research confirms that HCs should be measured using both physical characteristics of the household, such as access to electricity, water, flushable indoor toilets, etc., and environmental factors of the regions, such as pollution, noise, etc. [64]. The former are referred to as factors enabling the use of housing (including the standard of housing, the size of the area and number of rooms, the provision of technical and sanitary sets, technical condition, etc.) [65]. The second, in turn, are referred to as factors related to the housing environment. Researchers also point to financial factors (e.g., mortgage or rent arrears) as relevant to analyses related to HC assessment [66].

HCs are an important aspect illustrating QoL [56]. They include utility, emotional and prestige value [67]. They have been shown to affect an individual's physical, psychological, social and economic status [68]. The literature confirms their importance for the QoL of children [69], the elderly [70] and people with disabilities [56]. Medical studies have emphasized that adequate HCs are a prerequisite for health [71] and determine a quality life. Indeed, housing is seen as a "key determinant of health", as it has been found that "good housing and good health go hand in hand" [72].

Adequate HCs reflecting the quality of housing is considered an important component of well-being [73,74], life satisfaction [75,76] and QoL [77,78]. Lack of housing or living in inadequate housing conditions leads to unmet basic needs and is a direct cause of the phenomenon of housing poverty [79,80].

3. Materials and Methods

The research conducted focused on assessing QoL and HCs and comparing these categories in European Union countries in 2019 and 2022.

Taking into account the complex and multifaceted nature of a category such as QoL, variables from different areas of life, both objective and subjective in nature, were used to achieve the goal. QoL is a category that is difficult to measure, which is related to its dual nature. Measuring QoL in objective terms appears to be a simpler issue compared to measuring those aspects of a person's life that are subjective in nature and difficult to quantify. QoL is often equated with happiness or satisfaction in various areas of life. The variables adopted in this study of QoL relate to such aspects of life as health, needs, safety, happiness, gender equality or environmental protection. The category that was considered by the authors to be fundamental due to its importance for QoL is HCs. The variables describing them not only include data on technical parameters and financial issues, but also those related to the housing environment. The characteristics of the housing stock variables provide information not only about its quality, the financial burden of using the

dwelling and factors describing the environment of the dwelling, but also indirectly about the physical and psychological comfort of the population living in the described stock, their sense of security, the social, economic and health situation of the population in question, and thus ultimately about QoL.

Multi-criteria decision-making (MCDM) methods are often used to assess complex phenomena. In recent years, these methods have been used to solve complex problems with multiple criteria. One of the more commonly used MCDM methods is the TOPSIS method, which belongs to the linear object ordering methods. The TOPSIS method is used in the assessment of many complex phenomena, such as sustainable development in EU countries [81], sustainable development of corporate [82], the labor market [83], quality of life [84], tourism and hospitality [85], energy [86] or the assessment of the use of renewable energy sources [87].

TOPSIS is an acronym for "Technique for Order Preference by Similarity to an Ideal Solution". This method was introduced in the work of C.L. Hwang and K. Yoon [88]. It consists in determining the distance of each multi-feature object from the pattern and anti-pattern of development and then the linear arrangement of these objects. The basic tool is a synthetic measure of the level of the studied phenomenon, which is an aggregating function of partial indicators. When determining the value of this measure, several stages of the procedure are distinguished, as shown in Figure 2.

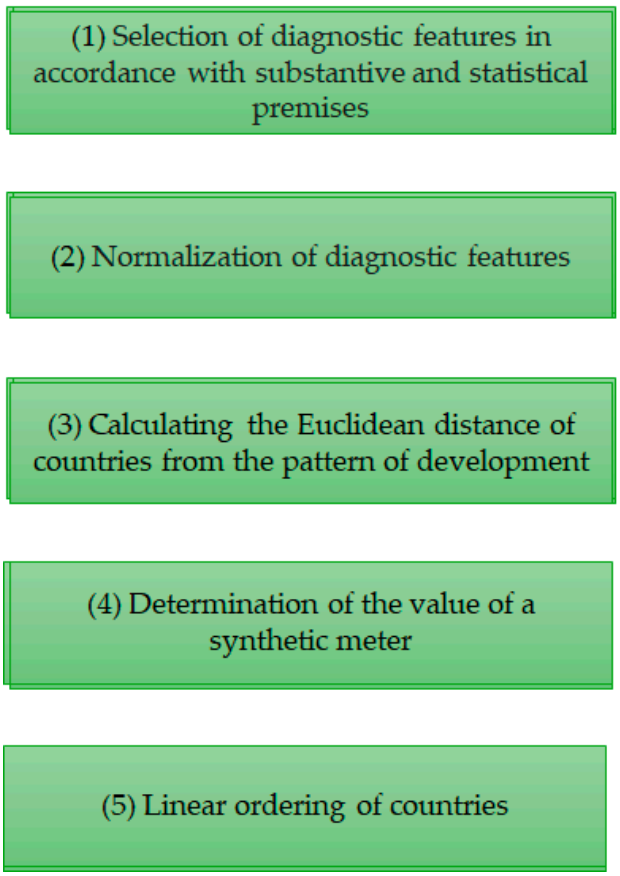

Figure 2. Stages of this study.

An extremely important step in the use of methods of multivariate comparative analysis due to the level of a complex phenomenon is the selection of diagnostic variables. The literature makes substantive and statistical demands on diagnostic variables [89]. The substantive criterion refers to the role of these variables in describing the phenomenon under study; they should play a significant role in characterizing the phenomenon under

study. The statistical criterion, on the other hand, emphasizes the variability and correlations between variables, which should have a sufficiently high degree of variability and be weakly correlated with each other. In addition, the values of the diagnostic variables should be available to guarantee the completeness of the data [90].

This study, in which one of the research objectives was to compare the situation of EU countries in terms of QoL and HCs, used the indicators presented in the next section of the article. This study refers to two years, 2019 and 2022; that is, it refers to the year before and after the COVID-19 pandemic. It is very important that the dataset in these two years contains the same indicators, so that a comparative analysis of QoL and HCs in EU countries can be made.

In the first stage of determining the value of the measure, a set of diagnostic features is determined in accordance with substantive and statistical premises. The substantive approach is based on a qualitative assessment of the studied phenomenon, taking into account knowledge and economic theory. The statistical approach is aimed at limiting the set of diagnostic features and excluding those features that poorly characterize the examined objects within the scope of the adopted criterion. An analysis of variability is often used, which should discriminate against the studied objects, i.e., differentiate them in terms of the adopted feature. For this purpose, the coefficient of variation is calculated according to the following formula:

$$v_j = \frac{s_j}{\overline{x}_j} \cdot 100\% \quad (1)$$

where s_j is the standard deviation of the j-th feature and $\overline{x}_j$ is the arithmetic mean of the j-th feature.

The most common assumption is that those variables for which the coefficient of variation takes a value of less than 10% are eliminated from this study.

In the next step, variables that are excessively correlated with other variables should be eliminated from the initial set of variables. A useful method in the selection of potential diagnostic variables is that of analyzing the elements of the inverse matrix of correlation coefficients of potential variables. This procedure follows the following steps [91]:

1. Calculation of values of correlation coefficients between variables and creation of a matrix R;
2. Determination of the inverse matrix R^{-1};
3. Elimination from the set of potential variables for which the diagonal elements of the matrix R^{-1} exceed the value of 10, which means bad numerical conditioning of the matrix R.

In the next stage, a matrix of observations is created, and the type of variables is determined, dividing them into stimulants, destimulants and nominates.

The observation matrix created is of the following form:

$$X = [x_{ik}] \quad (2)$$

where i is the object number (i = 1, 2, . . ., n), k is the diagnostic feature number (k = 1, 2, . . ., m), and x_{ik} is the value of the k-th feature for the i-th object.

In the second step, the variables are normalized in order to bring them to comparability. One of the methods used in this step is min–max scaling, which yields values of variables normalized within a range of $\langle 0; 1 \rangle$. This method uses the zero unitarization formula [92].

In this method, the normalization transformation for the variables defined as stimulants is performed according to the following formula:

$$z_{ik} = \frac{x_{ik} - \min\limits_{i} x_{ik}}{R} \tag{3}$$

while for destimulates, the following transformation is used:

$$z_{ik} = \frac{\max\limits_{i} x_{ik} - x_{ik}}{R} \tag{4}$$

where $R = \max\limits_{i} x_{ik} - \min\limits_{i} x_{ik}$.

In stage number three, the Euclidean distances of objects from the development pattern are calculated (z_k^+) and anti-pattern of development (z_k^-) according to the following formulas:

$$d_i^+ = \sqrt{\sum_{k=1}^{m} \left(z_{ik} - z_k^+\right)^2} \tag{5}$$

$$d_i^- = \sqrt{\sum_{k=1}^{m} \left(z_{ik} - z_k^-\right)^2} \tag{6}$$

The coordinates of the pattern and anti-pattern are determined according to the following formulas:

$$\left(z_1^+, z_2^+, \ldots, z_k^+\right) = \left(\max\limits_{i} z_{i1}, \max\limits_{i} z_{i2}, \ldots, \max\limits_{i} z_{ik},\right) \tag{7}$$

$$\left(z_1^-, z_2^-, \ldots, z_k^-\right) = \left(\min\limits_{i} z_{i1}, \min\limits_{i} z_{i2}, \ldots, \min\limits_{i} z_{ik},\right) \tag{8}$$

If min–max scaling is used as a normative formula, then
$z^+ = 1$ and $z^- = 0$ for each k.

In the next, fourth stage, the value of the synthetic meter is determined according to the following formula:

$$s_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{9}$$

Higher meter values (s_i) indicate a higher position of the object in linear ordering due to the phenomenon under study.

In the last step, the objects are ordered according to the increasing value of the measure s_i.

4. Results

4.1. Characteristics of the Research Material

Table 2 presents potential indicators characterizing QoL in EU countries [93,94].

Table 2. Potential indicators characterizing QoL.

Variable	Variable Name	Unit of Measure	Characteristics
Y_1	Healthy life years at birth	Years	The indicator of healthy life years (HLYs) measures the number of remaining years that a person of a specific age is expected to live without any severe or moderate health problems. HLYs are a composite indicator that combines mortality data with health status data.

Table 2. *Cont.*

Variable	Variable Name	Unit of Measure	Characteristics
Y_2	Share of people with good or very good perceived health	Percentage	This indicator is a subjective measure on how people judge their health in general on a scale from "very good" to "very bad". It is expressed as the share of the population aged 16 or over perceiving itself to be in "good" or "very good" health. The data stem from the EU Statistics on Income and Living Conditions (EU SILC). Indicators of perceived general health have been found to be a good predictor of people's future healthcare use and mortality.
Y_3	Standardized preventable and treatable mortality	Rate	Avoidable mortality covers both preventable and treatable causes of mortality. Preventable mortality refers to mortality that can mainly be avoided through effective public health and primary prevention interventions.
Y_4	Self-reported unmet need for medical examination and care	Percentage	This indicator measures the share of the population aged 16 and over reporting unmet needs for medical care due to one of the following reasons: 'Financial reasons', 'Waiting list' and 'Too far to travel' (all three categories are cumulated). Self-reported unmet needs concern a person's own assessment of whether they needed medical examination or treatment (dental care excluded) but did not have it or did not seek it.
Y_5	Obesity rate by body mass index (BMI)	Percentage	This indicator measures the share of obese people based on their body mass index (BMI).
Y_6	Fatal accidents at work per 100,000 workers	Incidence rate	This indicator measures the number of fatal accidents that occur during the course of work and lead to the death of the victim within one year of the accident. An accident at work is 'a discrete occurrence in the course of work which leads to physical or mental harm'. This includes all accidents in the course of work, whether they happen inside or outside the premises of the employer.
Y_7	Road traffic deaths, by type of roads	Rate	This indicator measures the number of fatalities caused by road accidents, including drivers and passengers of motorized vehicles and pedal cycles as well as pedestrians. Persons dying in road accidents up to 30 days after the occurrence of the accident are counted as road accident fatalities.
Y_8	Premature deaths due to exposure to fine particulate matter (PM2.5)	Rate	This indicator estimates the number of premature deaths attributable to long-term exposure to PM2.5. PM2.5 are particulates whose diameter is less than 2.5 micrometers and which can be carried deep into the lungs, where they can cause inflammation and exacerbate the condition of people suffering heart and lung diseases. The data were calculated per 100,000 people.
Y_9	Neonates dying before 28 days of age, per 1000 births	Rate	Mortality during the neonatal period accounts for a large proportion of child deaths and is considered to be a useful indicator of maternal and newborn neonatal health and care (neonatal mortality rate (0 to 27 days) per 1000 live births).
Y_{10}	Happiness Index	Points	The Happiness Index is a comprehensive survey instrument that assesses happiness, well-being, and aspects of sustainability and resilience. Zero points means unhappy; ten means happy. Source: The World Happiness Report.

Table 2. *Cont.*

Variable	Variable Name	Unit of Measure	Characteristics
Y_{11}	Women in parliament	Percentage	The presence of women in parliament is a measure of equality and testifies to the overall political and social maturity of the country.
Y_{12}	Material deprivation rate	Percentage	This indicator is defined as the percentage of population with an enforced lack of at least seven out of thirteen material deprivation items that individuals cannot afford: to pay rent or utility bills, keep their home adequately warm, face unexpected expenses, eat meat, fish or a protein equivalent every second day, a week's holiday away from home, a car, a washing machine, a color TV, or a telephone.
Y_{13}	Tertiary educational attainment	Percentage	This indicator measures the share of the population aged 25–34 who have successfully completed tertiary studies. The indicator is based on the EU about Force Survey (EU-LFS).
Y_{14}	Average CO_2 emissions per km from new passenger cars	g CO_2 per km	This indicator is defined as the average carbon dioxide (CO_2) emissions per kilometer of new passenger cars in a given year.
Y_{15}	Share of renewable energy in gross final energy consumption	Percentage	This indicator indicates the country's progress in the energy transition. It shows how much of the total energy consumed by society comes from renewable sources such as solar, wind, hydro, geothermal or biomass.
Y_{16}	Overall life satisfaction	Points	The degree to which a person evaluates the overall quality of their present life as a whole positively.
Y_{17}	Persons having someone to rely on in case of need	Percentage	This indicator of the quality of life, social inclusion and health of individuals. It reflects an individual's sense of security and the quality of social relationships in a given group or society.

Table 3 shows the values of the basic parameters of the distribution of potential indicators characterizing QoL.

EU countries are differentiated to varying degrees in terms of the variables presented in Table 1. The strongest country differentiation was noted for the variables Y_4, Y_8, Y_{12} and Y_{15}. Many indicators result in strong or moderate variability among EU countries. Exceptions include the indicators Y_1, Y_5, Y_{16} and Y_{17}, which showed weak volatility ($v_j < 10\%$) in every year studied. For this reason, indicators numbered 1, 5 and 17 were excluded from further analysis. Finally, indicators that were characterized by strong variability were accepted for this study.

The distributions of the indicators remaining in this study are characterized by different direction and different strength of asymmetry. The strongest asymmetry, in the positive direction, was noted for indicators numbered 4, 12 and 15. In the case of Y_4 and Y_{12}, the positive direction of the asymmetry of the distribution is a desirable phenomenon, signifying the presence of lower levels of unmet need for medical checkups and care and lower material deprivation compared to the EU average in most EU countries. In contrast, the positive asymmetry for Y_{15} means that there is still a lower share of RES energy in final consumption than the EU average in most EU countries. When analyzing other QoL indicators, several positive changes can be noticed, which include an improvement in the average values of indicators numbered 5, 7, 9 and 10–15. For several indicators (2, 3, 4 and 8), a deterioration of average values was recorded, which may affect the deterioration of QoL of residents. These indicators refer to the sphere of life of a population related to health and health protection. The Y_3 value has increased significantly, which is associated

with an increase in mortality, which can be prevented and avoided mainly through effective public health and primary prevention interventions. Another worrying phenomenon is the increase in the average number of premature deaths, which can be attributed to long-term exposure to PM2.5.

Table 3. Basic descriptive characteristics of indicators describing QoL in 2019 and 2022.

Variable	Year	Mean	Median	Min	Max	Standard Deviation	Coefficient of Variation	Skewness
Y_1	2019	62.39	62.00	53.10	73.30	5.22	8.37	0.48
	2022	62.10	61.20	54.20	70.20	3.91	6.29	0.10
Y_2	2019	67.16	68.60	46.20	84.30	9.44	14.04	−0.66
	2022	66.95	67.80	48.10	80.80	8.30	12.40	−0.70
Y_3	2019	280.03	225.13	164.92	504.81	112.12	40.04	0.85
	2022	347.97	244.51	177.48	694.80	177.012	50.87	0.87
Y_4	2019	2.47	1.40	0.00	15.50	3.14	126.87	2.96
	2022	2.56	1.80	0.10	9.10	2.45	95.80	1.46
Y_5	2019	55.19	55.90	45.70	64.80	4.87	8.82	−0.02
	2022	54.34	54.60	41.90	62.50	4.84	8.91	−0.59
Y_6	2019	1.97	2.01	0.48	3.53	0.86	43.59	0.10
	2022	1.97	1.87	0.33	4.29	1.00	50.83	0.51
Y_7	2019	5.28	5.00	2.20	9.60	1.89	35.76	0.61
	2022	4.81	4.80	2.20	8.60	1.52	31.64	0.75
Y_8	2019	51.07	41.00	3.00	142.00	33.02	64.64	0.67
	2022	57.26	44.00	3.00	158.00	40.58	70.87	0.56
Y_9	2019	2.26	2.00	1.00	4.00	0.75	33.19	0.07
	2022	2.15	2.00	1.00	4.00	0.76	35.17	0.28
Y_{10}	2019	6.44	6.22	5.01	7.77	0.72	11.12	0.03
	2022	6.63	6.59	5.47	7.80	0.54	8.22	0.25
Y_{11}	2019	29.50	28.70	12.56	47.28	9.74	33.01	0.27
	2022	31.55	31.79	14.07	46.42	9.30	29.48	−0.15
Y_{12}	2019	8.68	6.50	1.10	30.40	7.50	86.45	1.66
	2022	8.42	6.60	1.70	31.60	7.19	85.34	2.00
Y_{13}	2019	42.55	42.40	25.50	60.30	8.65	20.34	0.01
	2022	44.84	43.90	24.70	63.00	9.72	21.68	0.01
Y_{14}	2019	147.79	150.00	119.30	161.20	10.39	7.03	−0.82
	2022	115.59	119.20	66.60	141.60	19.80	17.13	−0.67
Y_{15}	2019	22.43	18.18	7.05	55.79	11.69	52.15	1.06
	2022	25.73	20.80	13.11	66.00	12.52	48.65	1.54
Y_{16}	2019	7.20	7.30	5.40	8.10	0.62	8.61	−0.89
	2022	7.21	7.20	5.60	7.90	0.48	6.68	−1.28
Y_{17}	2019	92.60	93.40	81.70	97.60	4.27	4.61	−1.36
	2022	91.95	94.40	70.70	97.00	5.91	6.42	−2.26

The potential variables presented in Table 4 were used to assess of HCs in EU countries [93,94].

Table 4. Indicators characterizing the HCs.

Variable	Variable Name	Unit	Characteristics
X_1	Household overcrowding rate	Percentage	This indicator is defined as the percentage of the population living in an overcrowded household that does not have enough rooms relative to the number of household members.
X_2	Total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor	Percentage	This indicator is defined as the percentage of the total population living in a dwelling with a leaking roof, damp walls/floors/foundation, or rot in window frames or floor.
X_3	Total population having neither a bath nor a shower in their dwelling	Percentage	This indicator measures the share of total population having neither a bath nor a shower in their household.
X_4	Total population not having indoor flushing toilet for the sole use of their household	Percentage	This indicator is defined as the percentage of the total population not having indoor flushing toilet for the sole use of their household.
X_5	Total population considering their dwelling as too dark	Percentage	This indicator is defined as the percentage of the total population considering their dwelling as too dark and not having enough light.
X_6	Inability to keep home adequately warm	Percentage	This indicator is understood as the percentage of households that are unable to maintain a comfortable temperature in their home, most often due to the general condition of the building, the outside temperature and the cost of energy.
X_7	Persons who cannot afford internet connection for personal use at home	Percentage	This indicator is defined as the percentage of the total population that cannot afford internet connection for personal use at home.
X_8	Percentage of population living in households in which total housing costs consume more than 40% of disposable income	Percentage	This indicator illustrates the proportion of the population living in households where total housing costs ('net' after housing allowances) represent more than 40% of disposable income ('net' after housing allowances).
X_9	Arrears on mortgage or rent payments	Percentage	This indicator shows the percentage of households that have difficulty paying their housing cost obligations on a regular basis.
X_{10}	Noise from neighbors or from the street	Percentage	This indicator is defined as the percentage of the total population who report experiencing excessive noise in the apartment coming from neighbors or from outside the street (traffic, industrial plants, or business activities).
X_{11}	Pollution, grime or other environmental problems	Percentage	This indicator is defined as the percentage of the total population who report feeling that their area is polluted, is dirty or has other environmental problems such as dust, smoke, unpleasant odors, or contaminated water.
X_{12}	Crime, violence or vandalism in the housing environment	Percentage	This indicator is defined as the percentage of the total population who report feeling that their area experiences crime, violence or vandalism in an area.

Table 5 shows the potential values of the basic parameters of the distribution of indicators characterizing HCs in EU countries in 2019 and 2022.

Table 5. Basic descriptive characteristics of potential indicators describing HCs in EU countries in 2019 and 2022.

Variable	Year	Mean	Median	Min	Max	Standard Deviation	Coefficient of Variation	Skewness
X_1	2019	18.01	13.90	2.20	45.80	13.61	75.58	0.75
	2022	17.24	15.10	2.20	41.70	12.25	71.06	0.66
X_2	2019	13.61	12.50	4.10	31.10	5.89	43.31	1.05
	2022	13.54	13.50	4.80	31.60	6.96	51.40	0.89
X_3	2019	2.61	0.50	0.00	22.80	4.90	187.38	2.99
	2022	1.82	0.50	0.00	14.20	3.06	167.90	2.84
X_4	2019	2.79	0.50	0.00	24.20	5.38	193.19	2.88
	2022	1.86	0.40	0.00	15.40	3.45	185.34	2.85
X_5	2019	5.22	5.00	2.60	10.00	1.88	35.99	0.68
	2022	5.51	5.00	2.90	10.60	2.12	38.45	0.73
X_6	2019	8.20	5.40	1.80	30.10	7.71	94.03	1.62
	2022	8.63	6.80	1.40	22.50	6.14	71.15	0.90
X_7	2019	3.43	2.30	0.30	21.10	4.08	118.69	3.31
	2022	2.10	1.60	0.30	9.10	2.09	99.48	2.33
X_8	2019	8.28	6.10	2.30	36.00	6.47	78.18	3.10
	2022	7.89	6.60	2.50	26.70	5.16	65.41	2.00
X_9	2019	2.83	2.40	0.50	10.50	2.02	71.46	2.22
	2022	2.57	1.90	0.50	9.50	2.02	78.58	1.90
X_{10}	2019	15.83	14.50	8.20	28.30	5.58	35.29	0.61
	2022	16.90	15.50	6.70	31.30	7.39	43.70	0.49
X_{11}	2019	13.56	13.10	5.90	33.90	5.87	43.27	1.71
	2022	11.89	10.50	4.20	34.70	5.95	50.05	2.12
X_{12}	2019	9.76	8.40	2.70	20.20	4.32	44.32	0.49
	2022	8.57	7.00	1.40	20.90	4.61	53.80	0.85

All indicators describing the HCs of the populations produced at least strong variability among EU countries in each year studied. The most varied were the countries in terms of indicators numbered 3, 4 and 7. However, it was noted that the differentiation of EU countries in terms of these indicators decreased in 2022.

The distributions of the indicators studied were characterized, in every year studied, by right-handedness and at least strong asymmetry. The strongest asymmetry concerned the indicators X_3, X_4, X_7, X_8, X_9 and X_{11}. Since all the indicators adopted for the description have a destimulating effect on the HCs of the populations, the rightward asymmetry is a welcome phenomenon and means that most EU countries recorded average values of indicators lower than the EU average. Improvements in the average values of indicators were noted for X_1–X_4, X_7–X_9 and X_{11}–X_{12}. However, for X_5, X_6 and X_{10}, a deterioration in average values was noted. A worrying phenomenon is the increase in the average percentage of the populations that have reported inconvenience from neighbors and street noise. The deterioration of HCs may also be evidenced by an increase in the percentage of residents who consider their apartment too dark or the inability to maintain adequate heat at home.

4.2. Results of Ordering EU Countries in Terms of QoL and HCs

To determine the values of s_i measures for EU countries in terms of QoL and HCs in 2019 and 2022, the procedure shown in Figure 1 was used. From the set of indicators characterizing QoL, Y_1 was removed due to its low variability in both years studied. Taking into account the criterion of correlation of variables and using the method of inverted correlation coefficient matrix, the variable Y_3, which showed excessive correlation with such indicators as Y_2, Y_7 and Y_{12}, was removed from the set of variables. The inverted matrix of correlation coefficients after the elimination of Y_3 did not show bad numerical conditioning; that is, there were no values greater than 10 on the main diagonal.

A similar procedure was applied to the indicators characterizing HCs. The following were removed from the set of potential variables X_3, X_4 and X_7, for which the diagonal elements in the inverted matrix of correlation coefficients were greater than 10.

After creating the final observation matrix containing the values of QoL and HC indicators, the types of indicators were determined, and among them, stimulants, destimulants and nominants were distinguished. It was found that there were no nominants among the indicators. Indicators Y_4–Y_9, Y_{12} and Y_{14} were found to be destimulants with respect to QoL. In contrast, all indicators describing HCs have a destimulant effect on HCs. In the next step, normalization of variables was carried out according to Formulas (3) and (4). On the basis of the normalized values of the indicators, the values of the s_i meter were determined according to Formula (9). The distributions of the values of the meter are presented in Figure 3.

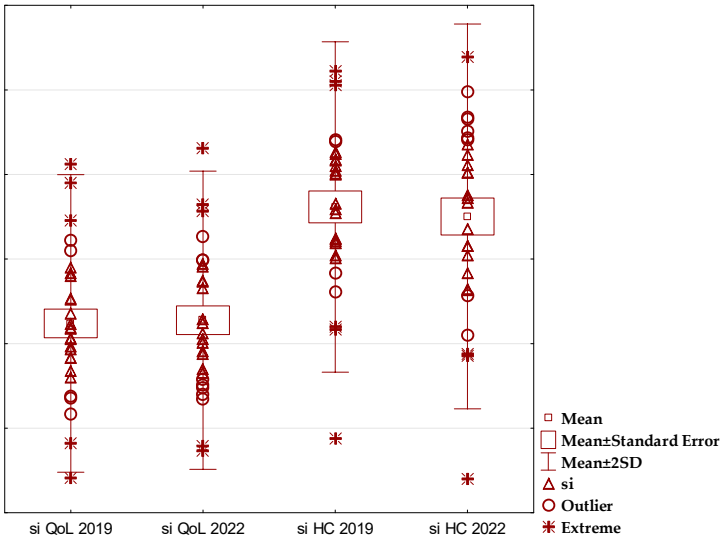

Figure 3. Distributions of meter values s_i.

As Figure 3 shows, there are outliers and extreme values among the measure values s_i. In the case of the measure distributions for QoL in 2019, extreme values were found for Sweden, Finland and Denmark (highest) and Bulgaria and Romania (lowest), while outliers were found for the Netherlands and Ireland (high) and Croatia, Hungary and Greece (low). In 2022, outliers included the value of the meter for Sweden and Denmark (highest) and Bulgaria (lowest). In addition, outliers included the size of the meter for Finland and the Netherlands (high) and Romania, Croatia and Hungary (low).

For HC metrics in 2019, extreme values were recorded for Finland and Czechia (highest) and Bulgaria and Greece (lowest), and outliers were recorded for Estonia and Ireland (high) and Malta and Portugal (low). In 2022, measures for Estonia (highest) and Greece and Spain (lowest) took on extreme values. Despite the presence of extreme and outlier meter values, the s_i distributions for QoL and HCs are characterized by at most moderately

strong asymmetry. The s_i distributions for QoL and HCs differ in the direction of asymmetry; the distributions of the measure for QoL are characterized by right-sided asymmetry, while those for HCs are left-sided. Based on the values of s_i measures, a linear ordering of EU countries in the years 2019 and 2022 in terms of QoL and HCs was made (Table 6).

Table 6. Ranking of EU countries in terms of QoL and HCs in 2019 and 2022.

Country	Rank of Countries in Terms of					
	Quality of Life			Housing Conditions		
	2019	2022	Change	2019	2022	Change
Austria	6	7	↓	6	11	↓
Belgium	8	5	↑	16	12	↑
Bulgaria	27	27	–	26	21	↑
Croatia	25	23	↑	5	3	↑
Cyprus	16	13	↑	22	22	–
Czechia	18	12	↑	2	2	–
Denmark	3	2	↑	10	8	↑
Estonia	15	14	↑	3	1	↑
Finland	2	3	↓	1	10	↓
France	12	15	↓	17	26	↓
Germany	10	10	–	21	20	↑
Greece	23	25	↓	27	27	–
Hungary	24	24	–	14	15	↓
Ireland	5	6	↓	4	9	↓
Italy	19	20	↓	11	14	↓
Latvia	17	22	↓	23	18	↑
Lithuania	21	17	↑	18	13	↑
Luxembourg	11	8	↑	15	16	↓
Malta	13	18	↓	25	23	↑
Netherlands	4	4	–	20	17	↑
Poland	22	21	↑	9	6	↑
Portugal	14	16	↓	24	24	–
Romania	26	26	–	19	19	–
Slovakia	20	19	↑	7	5	↑
Slovenia	9	9	–	8	7	↑
Spain	7	11	↓	13	25	↓
Sweden	1	1	–	12	4	↑

↑—improvement in ranking position, ↓—deterioration in ranking position.

Ten EU countries saw a decrease in ranking position in terms of QoL, and another ten saw an increase in position, while for seven, their positions were unchanged. In the case of the ranking for HCs, only eight countries had worsened their positions, as many as 14 countries improved their positions, and only five countries did not change their positions.

The largest positive change in terms of QoL was observed for Czechia—by six positions. In contrast, the largest deterioration in ranking position was observed for Latvia and Malta—by five. When evaluating HCs in EU countries, Sweden was found to have improved the most—by 8 positions, while Spain, Finland and France saw the largest deterioration in ranking position—by 12 and 9 positions (Finland as well as France), respectively.

Sweden ranked first in terms of QoL in both years studied, followed by Finland, Denmark and the Netherlands. The countries listed as leaders in the ranking are characterized by the values of many indicators influencing high QoL, such as fatal accidents at work per 100,000 workers, road traffic deaths, by type of roads, Happiness Index, women in parliament, material deprivation rate, tertiary educational attainment and share of renewable energy in gross final energy consumption. In addition, Sweden has a low percentage of

people reporting unmet needs for medical checkups and care, very low rates of premature deaths due to exposure to fine particulate matter (PM2.5) and neonates dying before 28 days of age per 1000 births and average CO_2 emissions per km from new passenger cars. The bottom-ranked countries were Bulgaria, Romania, Croatia and Greece. These countries recorded high values of the indicators road traffic deaths and premature deaths due to exposure to fine particulate matter (PM2.5). The Y_8 value exceeded the EU average in Bulgaria by almost three times in 2022. In addition, these countries have a low proportion of women in parliament and a high rate of material deprivation. In Bulgaria and Romania, unfavorable phenomena were observed in health and education, expressed in the high number of deaths from traffic accidents, the high value of the material deprivation index and low values of the percentage of people with tertiary education. In addition, Bulgaria has a very low share of RES energy in gross final energy consumption.

The linear ordering of EU countries showed that Czechia, Estonia and Croatia have a stable leading position in the ranking in terms of HCs. In contrast, countries such as Greece, Bulgaria, Malta and Portugal have occupied some of the last places in every year studied. The biggest positive change in the ranking was observed for Sweden, which rose from 12th place in 2019 to 4th in 2022. Most countries (14) improved their rankings by at least one position. Noteworthily, in addition to Sweden is Poland, which saw a rise of three places. The largest unfavorable change was recorded for Spain, Finland and France, by 12 and 9 places, respectively. The changes to the inferior position in the ranking are much more pronounced compared to the changes to the superior position. Czechia, Estonia and Croatia owe their top rankings to low values: X_2, X_5, X_6, X_8, X_9, X_{11} and X_{12}. Among the countries with the lowest rankings were Greece, Bulgaria, Malta and Portugal, for which unfavorable values were observed for many indicators in both 2019 and 2022 (X_1, X_5, X_6, and X_8–X_{12}). An interesting situation was observed for Finland, France and Spain. Finland in 2019 held the first place in the ranking in terms of HCs and after 3 years lowered its position to tenth place. The deterioration in position is reflected in a significant increase in the value of indicators numbered 1, 2, 5, 6 and 12. In the case of France and Spain, there has been a deterioration in even more indicators, which also include variables X_8–X_{11}.

Analyzing the obtained rankings of EU countries in 2019 and 2022, it was noted that there are very strong positive correlations between the positions of countries in terms of QoL and HCs reflected in the very high value of Spearman rank correlation coefficients of 0.947 and 0.828. In contrast, the correlations between the positions of countries in terms of QoL and HCs in 2019 and 2022 show rather weak correlations in the positive direction amounting to 0.272 and 0.292, respectively (Table 7).

Table 7. Spearman rank correlation coefficient matrix for QoL and HCs in 2019 and 2022.

Spearman Rank Correlation Coefficients	QoL 2019	QoL 2022	HCs 2019	HCs 2022
QoL 2019	1.000	0.947	0.272	X
QoL 2022	X	1.000	X	0.292
HCs 2019	X	X	1.000	0.828
HCs 2022	X	X	X	1.000

EU countries in the rankings in terms of QoL in 2019 and 2022 occupy similar or the same positions, e.g., Sweden—1st position in both years, Netherlands—4th position in both years, Austria—positions 6 and 7, Estonia—positions 15 and 14, and Poland—positions 22 and 21. In the linear ordering in terms of HCs, one can see greater differences in the positions occupied by EU countries, e.g., France—17 and 26, Lithuania—18 and 13, and

Sweden—12 and 4. As indicated by the values of the Spearman rank correlation coefficients, the positions of some countries in terms of QoL and HCs vary, e.g., Belgium was ranked 8th for QoL and 16th for HCs in 2019. In the following year of the survey, it improved its positions in both rankings, ranking 5th and 12th, respectively. Large differences in positions in terms of QoL and HCs were noted for Belgium, Germany, Malta, the Netherlands and Poland. In contrast, countries such as Bulgaria, Greece and Romania occupy the final positions in both rankings. However, countries occupying top positions in both QoL and HC rankings were also observed: Ireland, Slovenia, Finland and Denmark.

5. Discussion and Conclusions

Sustainability research emphasizes the importance of QoL as an overarching development goal. Viewed in three aspects, economic, social and environmental, sustainability is linked to quality of life as reflected in the interrelationships and interdependencies. Both QoL and sustainability do not have a clear definition. They are complex phenomena involving many aspects of human life. In our research, we focus on one of these aspects: housing conditions, which play a fundamental role in meeting human needs. This study highlights the link between HCs and quality of life of residents in EU countries. Our analysis makes extensive use of indicators expressing subjective assessment of QoL in relation to mainly objective HCs. Variables that are subjective in nature significantly affect the assessment of QoL. Their variants or values depend largely on respondents' personal feelings and opinions, as well as their interpretation of the content of the question. Thus, the answers may vary depending on the context or situation of the interviewees. As mentioned earlier, such phenomena as quality of life, happiness, satisfaction or contentment are difficult to directly quantify, and answers to the same questions may vary from one survey to the next. In order to obtain the most reliable assessment of such phenomena, assessments should be made by combining subjective and objective indicators. In order to obtain a more complete picture of QoL and HCs, this study proposes an approach that captures both subjective and objective indicators simultaneously.

Our results indicate that there is a relationship between QoL and housing conditions in EU countries in 2019 and 2022. Thanks to the survey conducted in two years, it can be seen that some countries with a high quality of life have improved the HCs of their populations. Such countries include, for example, Sweden and Slovenia. However, according to the survey, in many countries, despite their fairly good HCs, the QoL of their populations remains at a lower level (Slovakia, Poland, Estonia, Croatia and Czechia).

Although QoL is considered by representatives of various scientific disciplines, the literature notes that there are not many studies showing the links between QoL and the HCs of the populations, which are fundamental to meeting needs. Authors studying QoL often focus on theoretical issues relating to QoL in the context of SD using existing indicators of measurement, such as the HDI (Human Development Index) or SSI (Sustainable Society Index) [95,96] or studies on the conceptual development of QoL of a selected group of people [97]. Reviewing the literature, one can find studies showing links between QoL and various SD phenomena, such as climate change [81,98] and energy poverty [99]. The importance of HCs and their impact on the QoL of populations have been highlighted by researchers. HCs play a particularly important role during events such as the COVID-19 pandemic and the need to stay in isolation [100]. Other authors also evaluate HCs from the perspective of housing deprivation by examining it in relation to the level of urbanization of places of residence and other socioeconomic characteristics [101]. The present study uses both variables related to material deprivation, including housing, and other indicators related to different areas of life.

QoL research refers to populations living in different administrative areas. Many researchers focus on the study of QoL of residents of cities and/or villages or other local areas, which is extremely important from the point of view of management at the local level, because this is where decisions are made on the direction of development and the achievement of SD goals of small communities [102–106]. However, it is very important to assess the QoL of populations at the level of countries, especially when they operate within larger organizations, such as the EU, whose policies aim, among other things, to reduce differences between countries in the level of socioeconomic development, including the implementation of the SDGs. Our research has just been conducted for the 27 EU countries in two years: 2019 and 2022, i.e., before and after the COVID-19 pandemic.

Various methods, including quantitative ones, are used to assess QoL. The authors, given the complex nature of the categories under study—QoL, SD and HCs—they often use methods of multivariate comparative analysis such as DEA [107,108], regression models such as logit [101], structural models [109], or methods of ordering objects by selected aspects of QoL [110,111]. In this study, we propose the use of the selected method of linear ordering—TOPSIS—and Spearman's rank coefficients to compare the situation of countries in terms of QoL and HCs expressed by positions in the rankings. The TOPSIS method is a procedure applicable when large differences in the values of indicators reflected in the strong asymmetry of the distributions of variables are observed. In addition, in this study, we used sets of indicators to characterize QoL and HCs that capture the various aspects that make up these phenomena. With this approach, we propose a comprehensive picture of QoL and HCs. The indicators adopted in this study come from the Eurostat database, which ensures the reliability and high quality of the data; moreover, the data were standardized, which makes it possible to use them in comparative analyses of countries included in the Eurostat database.

The results obtained in the present work cannot be directly compared with the work of other authors, due to the sets of indicators used. As indicated, researchers often refer to the analysis of selected areas of QoL, while in our work we use a comprehensive approach to both QoL and HCs, taking into account many areas of the populations' life. A new approach presented in this study is to indicate the interaction between QoL and HCs. The authors believe that this approach is fully justified because the place of residence is the one where various needs from basic to higher-order needs are satisfied, and the standard of HCs has a significant impact on health, social relations and well-being, that is, QoL.

From analyzing the results obtained in this study, it can be concluded that

- EU countries are spatially diverse both unidimensionally and multidimensionally in terms of indicators characterizing QoL and HCs in the context of SD;
- Many EU countries (10) saw an improvement in QoL in 2022 compared to 2019, but at the same time, a deterioration in QoL as reflected in ranking positions was observed for 10 EU countries;
- In the case of HCs, there was an improvement in most EU countries (14) as highlighted by the ranking of countries;
- There were interactions of rather weak strength and positive direction between QoL and HCs;
- Despite the synergy between QoL and HCs in EU countries, weaker interactions between QoL and HCs were observed in some countries. Good HCs and, at the same time, lower QoL were observed, for example, in Croatia, Czechia, Estonia, Poland and Slovakia. The opposite situation, i.e., worse HCs and better QoL, was observed in Belgium, Denmark, Germany, Luxembourg, the Netherlands and Spain.

In the process of realizing the purpose of this study, the authors confirmed the existence of synergies between HCs and QoL in the EU space, both in 2019 and 2022. Thus, they

answered the research question posed in the introduction. The results obtained in the conducted study are particularly important in connection with the occurrence of the COVID-19 pandemic, which highlighted the importance of HCs especially during such a difficult time as the pandemic period and the need to stay in isolation [112].

Our study, which has many strengths, including unidimensionally and multidimensionally examining QoL and HCs in EU countries in two years—2019 and 2022, i.e., before and after the COVID-19 pandemic—and identifying the links between these categories, faced several limitations. Among the most common limitations, also pointed out by other authors basing their studies on quantitative methods [113], are data gaps. Some indicators—e.g., the consumption of antibiotics in the community and hospital sectors, defined daily doses (DDDs) per day—are not available for Germany, where there is no reporting on this indicator. This indicator is important for QoL because it reports on the amount of antibiotic use, the prevalence of bacterial infections and the efficiency of health services. For QoL, the missing data from 2022 were taken from 2021 and referred to two indicators: standardized preventable and treatable mortality and premature deaths due to exposure to fine particulate matter (PM2.5). During the data collection stage, there were also isolated missing values for some indicators, which were filled in using statistical methods.

Incomplete data also occurred for HCs, and in such a situation, their forecast was determined using a linear regression function. This problem occurred for 2022, with missing data from 2021, and affected the following HC variables: the total population living in an apartment building with a leaking roof, damp walls, floors or foundations, or rotting window frames or flooring, the total population not having either a bathtub or shower in their apartment, the total population not having a flush toilet in the home for exclusive household use, the total population that thinks its apartment is too dark, the total population that reports problems of noise from neighbors or from the street, the total population that reports problems of pollution, filth or other environmental problems, and the total population that reports problems of crime, violence and vandalism in the housing environment.

The data used, despite the limitations presented, provide an opportunity to assess changes and compare QoL and HCs prevailing in European Union countries.

QoL research in various aspects, including HCs, has a wide scope. Our future research will look not only at EU countries, but also at others outside Europe as well. Thanks to the analyses presented in this article, governments and EU institutions can monitor and compare the QoL of their populations, especially access to basic services: healthcare, education, transportation or just housing. Moreover, with information on the QoL of the populations of EU countries taking into account different areas of these populations, appropriate decisions can be made to reduce inequalities between regions or social groups.

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