

Towards the Evaluation of Possible Indicators for the Provision of Green Spaces in Settlements to Promote Physical Activity among the Population

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1 ABSTRACT

Publicly accessible and usable green spaces in cities and smaller settlements are important for promoting physical activity and consequently for maintaining and improving public health. Adequate provision of such spaces is crucial for planning of a quality living environment. Research to date has identified different aspects in linking public health and green spaces. However, the problems of existing approaches and methods include inconsistencies in evaluating different aspects of public spaces for physical activity, lack of inclusion of social and health benefits of green spaces in green space indicators, and lack of integrated approaches towards defining the provision of green spaces to promote physical activity. Accordingly, a solid spatially explicit indicator for assessing the provision of settlements with green spaces for physical activity is non-existent. The purpose of this paper is to present the literature review and methodological framework developed within the Slovenian research project titled Development of indicators for the assessment of the provision of settlements with green spaces for outdoor physical activity that addresses aspects of public green spaces and related indicators for assessing the adequacy of the conditions provided by urban green spaces for different types of physical activity. We have defined three basic types of physical activity, namely: activities that are carried out in one place, activities that cover distance for leisure or recreation, and activities that cover distance to reach a goal (i.e., daily active mobility). Guided by this definition, we conducted a literature review to examine: (1) which spatial aspects of enabling or promoting physical activity are addressed by existing green space indicators, (2) to which spatial scale and to which spatial planning levels are indicators linked and, (3) whether indicators address different types of physical activity. Based on the findings, suggestions are made to develop a more spatially explicit indicator to assess the provision of green spaces in settlements for the three types of physical activity. Such an indicator can strengthen the long-term monitoring of the condition of publicly accessible green spaces for recreational use by the population.

Keywords: physical activity, public health, green space provision, spatial planning, spatial indicators

2 INTRODUCTION

In recent years, attention to adequate physical activity has been raised by leading health organisations and official bodies on different levels. The World Health Organisation (WHO) has been promoting increased levels of physical activity to prevent chronic non-communicable diseases and maintain a healthy lifestyle, most recently with very precise recommendations for physical activity and health, which define the recommended amount of physical activity per week for different age groups (World Health Organization, 2020). Moreover, in Europe has the European Commission (EC), beside acknowledging the importance of raising physical activity of the population, recognised the importance of supporting a cross-sectoral approach to tackle unhealthy lifestyles. The EU Guidelines on Physical Activity (2008) give an important role to spatial planning and, in the guidelines for spatial planning, highlight the importance of creating an environment in which the population can be physically active, in particularly with regard to ensuring safe and comfortable everyday mobility, interlinking of recreational areas when building new neighbourhoods, the protection of the natural environment, and taking into account the needs of different population groups.

In recent years, the importance of spatial planning to support people's physical activity has been recognised also in Slovenia, not only in research but also in policy making. The national Resolution on the National Programme on Nutrition and Physical Activity for Health 2015–2025 (ReNPPTDZ, 2015) is an important document which supports cross-sectoral cooperation to tackle the inactivity of population and, among others, stresses the importance of ensuring a healthy living environment for all population. Furthermore, the Spatial Development Strategy of Slovenia (2004) is the overarching document that defines the objectives of spatial development and is the basic strategic spatial document for the coordination of sectoral policies. The new Draft (MOP, 2020) emphasises the pursuit of a high proportion of green spaces in cities, allowing residents

and visitors to socialise and recreate outdoors. Providing opportunities for healthy lifestyles in cities through the creation of green urban systems is also listed among the priorities for achieving the Strategy's objectives. Since 2017, the Ministry of Health has been funding activities to closely integrate different aspect of physical activity into spatial planning. As a result, the authors prepared a manual and guidelines to support municipalities in planning, evaluation, improvement and monitoring of public green open spaces for the population's physical activity (Šuklje Erjavec et al., 2020b). This study continues these efforts by inspecting indicators for the provision of green spaces to promote physical activity. We suspect that despite the existence of strategic documents such as the Spatial Development Strategy of Slovenia, and legislation in the field of spatial planning (e.g., Spatial Management Act (ZUreP-3)), which emphasise the importance of green spaces for the quality of the environment and the health of the population, methods and tools for evaluating the adequacy of the planned and existing spatial conditions of municipalities for a healthy lifestyle are scarce, and sectoral transfer of knowledge is only just starting to be established. We see the potential in developing an indicator which is adjusted to Slovenian spatial characteristics. The latter relate to small settlements size in comparison to other European countries, the absence of regional planning, the tendency towards an ageing population, giving priority to tourism over the needs of the local population, and land property regulations.

Accordingly, this study aims to critically inspect the literature to set a framework for the development of a spatially explicit indicator for assessing the provision of green spaces to promote physical activity, adjusted for Slovenian circumstances. We set the following research questions:

- (1) Do existing green space indicators address spatial aspects of enabling or promoting physical activity?
- (2) For which spatial scale and spatial planning levels are indicators of physical activities in green spaces designed?
- (3) Do these indicators address different types of activities?

To answer these questions, we performed a non-systematic review of existing aspects of green space and indicators of physical activities in green spaces. Based on the review, we set the framework for the assessment of aspects and indicators to support green space planning and management of Slovenian settlements.

3 NON-SYSTEMATIC REVIEW OF RELEVANT ASPECTS AND INDICATORS

3.1 Aspects of green space provision to promote physical activity in settlements

A growing body of research has examined how different aspects of green space, such as access, size and design features, relate to leisure and physical activities. Most of the literature highlights three aspects of provision: accessibility: proximity or coverage of a settlement based on established distance criteria; green space size and extent, which is mostly linked to population density within specific areas and the green space network; and assessment of quality, which is primarily focused on the presence of natural elements(see, for example, de la Barrera et al., 2016; Grunewald et al., 2017; Hillsdon et al., 2006).

In our review, we focused on aspects which are relevant for spatial planning. With this regard, Kaczynski and Henderson(2007) reviewed fifty quantitative studies and found that proximity to parks and recreational environments (public green spaces) is generally associated with people being more physically active. Qualitative evidence further suggests that safety, aesthetics, convenience, maintenance and proximity to public open spaces are important features that support physical activity(McCormack et al., 2010).In the Slovenian context, Šuklje Erjavec et al. (2020b)identified quality aspects of green space design to promote active lifestyles, highlighted from the perspective of urban and neighbourhood planning and partly through management. Based on these reviews, we further inspected aspects, important for the aims of this study. Each of them is briefly described and assessed in the following sub-sections.

3.1.1 Public access to green spaces

This aspects a basis to achieve equal opportunities for green space use and a key factor for assessing the green space provision of settlements. It is closely linked to the aspect of distribution, connectivity, and continuity of green spaces. Various studies have found that proximity to green spaces is crucial for its use (Cohen et al., 2007; Giles-Corti and Donovan, 2002; Harnik and Simms, n.d.). Most research methods are

based on measuring the distance of dwellings to the nearest green space. Usually they use buffers with a specific radius, most commonly a 300m for walking distance to the nearest green space(see for example Coles and Bussey, 2000; Giles-Corti and Donovan, 2002; Grahn and Stigsdotter, 2003; Nielsen and Hansen, 2007).In these studies, green spaces are often determined on the basis of land use data and their accessibility is measured with the geographic information system (GIS) tools. The problem with such approaches is that many public green spaces that are important for promoting physical activity are not included in the land use databases or are classified as some other land use (such as residential landscapes, hiking trails, urban forests, riverbanks and similar). Besides, distance radiuses quite often do not provide accurate information about accessibility due to different spatial barriers such as high traffic roads, railway lines, steep slopes but also lack of appropriate pedestrian and cycling pathways. Therefore, measurements of accessibility that use a network of existing pathways, e.g. the Network Analyst tool (Oh and Jeong, 2007) are much more accurate but less common mainly due to technical complexity of its use.

Furthermore, physical distance is just a part of the accessibility aspects. In addition to the physical distance, the time component is also important. Older people, parents with young children, or the disabled will take much longer to cover the same distance than a young, physically fit person(Biernacka et al., 2022; Kimpton, 2017). Therefore, an important factor in assessing accessibility is also the aspect of quality: universal design, safety, climatic and ambient pleasantness, attractiveness, etc.(Šuklje Erjavec et al., 2020b).

Accessibility is also strongly linked to perception of space and social inclusion, or a sense of belonging and acceptance. Some studies take into consideration the perceived accessibility of a green space and examine it by tools such as a user survey of subjective views or expert judgements based on various criteria (Sugiyama et al., 2008; Tilt et al., 2007) as well as other qualitative parameters (Giles-Corti et al., 2022).

3.1.2 Location and connectivity of green spaces

The location and connectivity of green spaces are important for the spatial distribution of green spaces in a settlement, also impacting their accessibility. The distribution of different types of green spaces is also particularly important in this context, as they allow for different forms of everyday use. The provision of multifunctional green spaces is therefore particularly important, especially in small settlements.

A balanced distribution of green spaces in settlements is key to ensuring that all residents have equal opportunities to use green spaces in their daily lives(Verma et al., 2020, Šuklje Erjavec et al., 2020). The distribution is important both at a larger scale (inter-urban, municipal) and at the local level(settlements, neighbourhoods).

Location of green spaces is often pre-defined by landscape characteristics of the settlement and its surroundings. Usually just a part of the public urban green space provision is designed and implemented completely anew. Therefore, their interconnectivity, in the form of pedestrian, cycle, and thematic routes as well as green space features, which in themselves provide stimulating settings for certain forms of physical activity, make an essential contribution to this aspect(Sander et al., 2017).

To ensure equal opportunities for all residents, green spaces need to be planned in a comprehensive and systematic way, considering population density and the distribution of existing publicly accessible green spaces. The most appropriate approach for the integrated planning of a balanced distribution and connectivity of green spaces is the design of a green system or green infrastructure. In Slovenia, as part of the comprehensive green system planning, a Green System Plan for Active Lifestyles is foreseen as a thematic concept of the green system of a settlement. It aims to provide appropriately distributed public green and other open spaces for physical activity of inhabitants(Bizjak et al., 2020).

3.1.3 Attractiveness of green spaces as support for their active use

The attractiveness of a place is a key factor in choosing open space for recreational use and the frequency of its use. Lundh (2017) notes that aesthetic experience is a primary consideration when choosing recreational places to visit, while comfort and meeting other people are important factors when spending time in outdoor spaces. The studies on urban environment attractiveness are often based on establishing indicators of the 'greenness' of a particular space, streets, neighbourhoods, cities. Despite the complex aspect of achieving quality, the quantity of natural elements is most often considered as a key parameter for the attractiveness. Attractiveness is most commonly inspected in studies through measuring natural features such as vegetation, water, animals, and the level of biodiversity (Lundh, 2017).

Methods based on satellite data have been implemented in the past to measure the presence of vegetation in specific areas (Sripada et al., 2006; Tucker, 1979), which include the ground plan representation of green areas, and methods from the perspective of the user, e.g. analyses of vegetation along streets using Google Street View, for example the greening view index (Ki and Lee, 2021). In addition to vegetation, other parameters are also used, e.g. for biodiversity including animals. Lundh (2017) used questionnaire-based and site-specific surveys for measurement of bird retention and detection in urban areas as parameter for the provision of ecosystem services. The measures for this aspect include the presence of natural elements, such as vegetation, water bodies, the evaluation of naturalness as well as potential disturbances and negative environmental effects.

Although the contact with nature is a proven factor of the attractiveness of green space for physical activity, there are some other crucial characteristics that should not be neglected when defining indicators. The biophysical characteristics of the environment such as air, water and soil quality are certainly a very important factor, but also the quality of the soundscape, and the absence of negative factors such as odour, dust, over-heating and dazzle (heat island), dereliction, etc. (Koohsari et al., 2015). Furthermore, the quality of the green space itself is also very important, reflected in its functionality for the use and its experiential and ambient quality (Francis et al., 2012; Pazhouhanfar, 2018).

3.1.4 Size of an individual green space and a total green space quantity in a settlement

This aspect is important in relation to the users' activities in green spaces and satisfying capacity. The determination of the quantity or extent of green spaces depends on the individual characteristics of settlements and their spatial affordances. Most used method for determining the quantity of green areas is the sum of all green spaces in relation to the total population (m²/inhabitant) or to the population in a given spatial unit. However, this method does not provide information either on the distribution of green spaces across a city or settlement, nor on their capacity for everyday use of or number of envisaged users (de la Barrera et al., 2016).

The WHO defined a standard of 9-11 m² of green spaces per capita, without specifying the spatial extent used to make calculations. Gupta et al. (2012) questioned the relevance of the information on urban green space per capita data, as it provides an imprecise and insufficient answer to the question of distribution and quality of green spaces in urban areas. In addition, the decision on where to set the boundary between the urban area and the hinterland can strongly influence the outcome of the calculation and the comparison of settlements. Increasingly popular are methods which rely on extracting the percent of green space from different land use databases, such as CORINE, EnviroAtlas or Urban Land Cover (ULC). The calculations are based on the proportion of green spaces in the area (Oh and Jeong, 2007; Van Herzele and Wiedemann, 2003; Wood et al., 2017), green spaces per one thousand inhabitants and ratio of green spaces to built-up area (so called green space factors).

Findings from a health-oriented study examining epidemiological aspects (Mitchell et al., 2011) showed that larger green spaces may be more important for health benefits than smaller spaces. The results also highlight that physical activity is one of the 'mechanisms' of health and that the quality of open space is difficult to measure, as perceptions are likely to vary according to the type of the user and their preferences. For example, a relatively wild space suitable for deep contact with nature may be rated as high quality by a lone walker, but low quality by a parent wishing to visit nature with young children (Mitchell et al., 2011).

The aspect of size is very relevant for Slovenian circumstances due to the dominance of small settlements. In Slovenia, only two cities have more than 100,000 inhabitants and the majority of urban settlements are very small. A commonly used size criterion of at least 1 ha or even 2 ha of green space may be suitable for very large cities, but is questionable for the use in smaller cities and settlements where small green spaces may be of great importance for the daily needs of the local population. Slovenian studies therefore suggest to use 250m² as the minimum size of green spaces that are taken into consideration when evaluating or analysing green space provision (Bizjak et al., 2020; Šuklje Erjavec et al., 2020b).

3.1.5 Variety of green spaces to ensure uses - types of green spaces

Akpinar (2016) researched different types of green spaces in terms of their health impacts on people. They found that not all green spaces should be treated equally and stressed the importance of having a variety of types of public green space rather than just a quantity of green spaces.

In general, all green spaces share very specific characteristics, which distinguishes them decisively from other open spaces, i.e., the presence of natural elements and thus their subordination to natural processes. However, they are very different from each other in other respects. That is in terms of their dominant characteristics (location, function, size and accessibility), nature (natural, urban, residential, connective, introverted, mass-visitor, private) and origin (natural, created). In planning practice, they can be classified according to their purpose such as ownership, predominant use (sport, recreation, rest, multifunctionality, etc.), and public accessibility (Šuklje Erjavec et al., 2020b), among others. According to their role, purpose and function, green spaces can be divided into individual green spaces (parks, recreation areas, etc.), green spaces, adjacent to buildings (e.g. schoolyards, kindergarten playgrounds, residential green spaces), green spaces that are part of buildings (green roofs and vertical greening), green spaces within other land uses (e.g. paths between meadows, urban forests), green spaces linked to transportation uses (avenues, car parks, pedestrian and cycle paths), and other open spaces incorporating natural features and green areas of special natural or cultural value (Šuklje Erjavec et al., 2020b).

We examined Slovenian legislation and national documents related to green spatial planning to understand whether an existing typology could support the aim of our study. We concluded that the existing approaches to land use planning are not adequate because they do not include all relevant types of green spaces that contribute to green space provision. For example, the Handbook on the Green System of Towns and Cities (Šuklje Erjavec et al., 2020a), which is part of the national spatial planning rules of the nearly adopted new National Spatial Order (“National Spatial Order,” 2023), offers a very comprehensive typology of green spaces which should support a variety of purposes and aims regarding green space planning. Based on reviewed aspects and aims of our study, we assessed it as not being fit for the purpose of this study. Accordingly, a specific approach was developed that adequately reflects the spatial requirements for the implementation of the important groups or types of the physical activity for health, while at the same time representing a suitable base for the guidelines to be used by the Ministry of Health as a National Spatial Planning Authority in the role of the monitoring and guiding spatial planning from the point of view of public health. With this objective in mind, we have identified three basic types of green spaces that are examined when defining green space provision. These are (1) Green spaces providing conditions for spatially concentrated physical activities, (2) linear green spaces providing conditions for distance-related physical activities and (3) open spaces providing conditions for physical activities as a means of travel – active mobility (Šuklje Erjavec et al., 2020a).

3.1.6 Equipment, safety and maintenance for the use of green spaces

The use of public open spaces is influenced by their equipment, safety, and maintenance. Different spaces require different levels of equipment and maintenance, depending on the type of space, the expected use, the intensity of natural processes in the area, etc. The safety aspect is usually achieved through the criteria as defined by the society, but it has also a subjective component related to an individual’s perception. Safety aspects relate to safety from injury and accidents, from violence, from negative influences from the environment and traffic safety (Šuklje Erjavec et al., 2020b). For the study and evaluation of all these aspects, qualitative methods that reflect the (dis)satisfaction of users with a particular space are usually needed, but there are also some more objective data available from evidence and records of the utility company or the service that maintains public green areas.

Research on the use of spaces in relation to user characteristics addresses the time component or duration of use of a green space and user characteristics, e.g., age, gender, education, income. Methods are usually based on the use of GPS technologies to detect spatial-temporal mobility patterns of the population. The use of GPS technologies on smartphones can provide information on how often and for how long people use green spaces for active use (Lachowycz et al., 2012; Nieuwenhuijsen et al., 2014). Conversely, surveys are often conducted through questionnaires and field visits. Questionnaires are mainly used to examine certain characteristics of the specific case studies design, and behavioural maps to examine how they are used. Lundh (2017), for example, identifies the key spatial characteristics for seating are a pleasant microclimate, an attractive view, an appropriate layout with a back screen and a sufficiently low noise level to allow conversation.

3.2 Green space indicators and promoting physical activity

Indicators are important tools of evaluation, monitoring and/or planning suitable green space provision of different settlements and other areas. To address the spatial component through the perspective of different types of activities in green space, the development of spatially explicit indicator for assessing the provision of green spaces to promote physical activity requires a review of existing indicators used for green spaces and the determination of physical activities in green spaces. In line with the objective of this study, we divided the review of indicators in three groups:(1) health indicators, which are important to inform the public and decision makers about the state of public health and to define objectives for improvement;(2) spatial quality indicators, which measure suitability of the spatial factors, and (3) environmental indicators measuring the quality of the environment for healthy active use. However, it is important to point out that these groups of indicators are intertwined.

Health indicators have been widely studied from different perspectives, including quality of life, well-being, walkability and physical activity. A review of health indicators by Pineo et al.(2018)emphasizes the importance of local measures and adapting indicators to local needs. With regard to physical activity, they found that it comprises 75.1% of environmental indicators, the most common being transportation, habits, living conditions, safety, land use, food, environment, demography, leisure and culture, and urban design. An important finding of their research is that data measured at the neighbourhood or individual levels are more suitable for identifying health inequalities and environmental characteristics that contribute to poor health. Indicators at this level can be used to inform development policies in these areas and monitor their impact over time (Pineo et al., 2018).The importance of the local level is one of the starting points for the development of the indicator for green spaces to promote physical activity.

From the point of view of spatial planning, including the provision of green spaces in settlements, indicators of spatial quality are of course particularly important. We have focused on the indicators that assess the suitability of spatial factors related to green spaces and health and thus consider aspects such as socio-economic benefits of green spaces, climate change mitigation, and improvements in urban quality of life. Although not so widely used as health and environmental indicators, there are some interesting research studies and cases related to green space indicators. Koohsari et al.(2015)for example identified criteria such as proximity, number, size, and attractiveness of these spaces. The findings of the study indicated also that the size and attractiveness of local public open spaces played a significant role in residents' preferences. Interestingly, the study revealed that having access to a larger and more attractive public open space, even if it required a greater walking distance, was often more important to residents than having access to a smaller public open space in close proximity to their home (Koohsari et al., 2015). This highlights the importance of considering not only proximity but also the size and attractiveness of public open spaces when evaluating their impact on residents' preferences and usage patterns.

To promote equal access of public green spaces, it is common to establish a "minimum standard for parks."Such standards typically outline the minimum amount of green space per person and the maximum distance to the nearest green space. However, Kimpton (2017)suggests that these standards lack precision when it comes to considering factors like frequency of use, diversity of green space types, and proximity to such spaces. To address this, indicators can be defined at different levels, such as plot, parts of settlements, city/town, and municipal levels. For assessing physical activity provision, both municipal and local level indicators are important. Municipal indicators allow for comparisons over time and between different cities or settlements, while local indicators help identify inequalities within cities or settlements that are not evident when using municipal level indicators (de la Barrera et al., 2016).

Indicators that emphasize measuring the quality of the environment have been identified through a review of existing indicators for green spaces. Several cities, including Berlin, Malmö, Seattle, Helsinki, London, Stockholm, North West England, Washington DC, Singapore, Toronto, and Vancouver, have developed indicators that assess the environmental impact and the proportion of green space in new projects, particularly in urban areas. These indicators are based on the adaptation of existing Green Space Factors (GSFs) used in Berlin and Malmö(Kruuse, 2011; Ring et al., 2021).They consider the ratio of green areas to plot size and take into account various types of greenery such as green roofs and walls, permeable pavements, water, trees, and rainwater systems such as rain gardens. They also consider the presence of different ground types regarding the relation to subsoils. The focus of these indicators is on the

environmental and ecological aspects of sustainable urban development. They not only assess the presence of natural elements but also serve as a qualitative measure of the attractiveness of outdoor spaces. According to Ring et al.(2021),the urban green space index promotes urban sustainability by addressing ecological and socio-economic benefits.

The urban green spaces indicator holds a significant role supported by research and international commitments. The European Green Deal places strong emphasis on the importance of green spaces and nature in cities, particularly public green spaces. Urban Greening Plans are instrumental in achieving these objectives by creating additional green spaces, improving connections between them, and protecting biodiversity (European Commission. Directorate General for Environment, 2021).The Green Deal recognizes the ecological and social aspect of urban green spaces, which includes also providing green spaces for the population and fostering interconnectedness among these spaces. These social aspects are further elaborated and specified in documents such as the Green System in Slovenia(Šuklje Erjavec et al., 2020a). The Green System in Slovenia outlines detailed guidelines and strategies for ensuring the provision of green spaces and enhancing their connectivity, thereby addressing the dimensions of the Green Deal. To align with the European Green Deal and the EU Biodiversity Strategy, Urban Greening Plans need to incorporate specific indicators, including the proportion of urban green spaces (public and private), tree canopy cover, newly planted trees, and protected natural areas in public spaces. These indicators are crucial for monitoring and guiding the development of green spaces in cities and municipalities. The Urban Greening Plan Guidance provides guidelines for mapping the land use types of municipalities, utilizing the official Corine land cover classification system(“Urban Greening Plan Guidance draft,” 2022).

To develop a spatially explicit indicator for assessing the role of green spaces in promoting physical activity, the review highlighted the importance of spatial indicators in general public health assessments. It also identified different approaches to defining indicators for green spaces, depending on their intended purpose. However, it is important to emphasize that international documents primarily focus on the provision of green spaces in urban areas also for the benefit and use of the population. These documents provide guidance and frameworks that prioritize the establishment of green spaces as a means to enhance public health and overall well-being.

4 SETTING A FRAMEWORK FOR GREEN SPACE PROVISION ASSESSMENT

Section 3 inspected the spatial aspects of indicators to address the provision of green spaces to promote physical activity. The next step is to identify the physical activities that relate to green spaces and their characteristics. Accordingly, we reviewed the literature on how each of the measured aspects of green space provision is addressed and combined in different indicators according to their purpose and specific criteria for each of the included aspects of green space provisioning.

4.1 Linking green spaces with physical activities

Due to the interlinking of spatial factors, local spatial and social characteristics, research generally neither determines the appropriate size of green space to increase physical activity, nor the quantity of amenity provision to encourage the use of public open space. Typically, research examining the links between attributes of public open space and physical activity are tied to individual case studies. Depending on the purpose of the physical activity provision indicators, the criteria can be adapted according to the type of activity, which leads towards considering types of activities.

Koohsari (2015)underlined the influence of green space on a variety of activities that share certain common characteristics in terms of (mainly daily) use of urban space. Public open spaces can influence physical activity in at least three ways: a public open space can be an environment where people engage in physical activity; a public open space can be a destination where people travel to be active or simply to socialise; a public open space can be used as part of a route to get to another destination (e.g., a shop) or as part of a recreational route for walking or jogging. Accordingly, green space can contribute to different types of physical activity. For example, green space as a thoroughfare is associated with active travel, as a destination with active travel or recreational physical activity, and public open space as an environment can be associated with recreational walking or cycling, jogging, dog walking, formal or informal sports or active play for children. Šuklje Erjavec et al. (2020b) made a step forward and set simple criteria of green space provision for active lifestyle. They specified three types of physical activity in terms of a design approach to

functions, usability, values, and perception of place. This means including the typology of green spaces, quality of setting and equipment, management level and similar.

From the Table 1 it is also evident that most of the reviewed indicators have been set to be used on a local level. This is an important step forward from the quantity indicators for a municipality or even regional and national level, however none of the indicators has directly addressed a physical activity for health. An exception are spatial indicators of urban design and transport features (Boeing et al., 2022), but they do not explicitly address green spaces.

Addressed/combined aspects in indicator	Level	Measures	A way of addressing physical activity	Selected sources
Quantity Accessibility	city level	distance variable on household level; coverage of green space (500m buffer), and household social characteristics	Through selection of open space type: addressing green urban areas and forests	Green space provision indicator in relation to the equality (Wüstemann and Kalisch, 2016)
Quantity Natural elements	Urban built plot/parcel	modelling the climatic characteristics of open space elements	Not directly; possible inclusion for activities addressed on individual plots	Green and open space factor (Ring et al., 2021)
Permeable soil Natural elements / greenery and water	Urban built plot/parcel or smaller urban unit - neighbourhood	Surface type (permeability), surface construction, soil depth, water infiltration, water surfaces, vegetation type	Not directly; on ecological and climatic environmental quality for sites	Green space factor (Kruuse, 2011); Biotope area factor – ecological value (“Der Biotopflächenfaktor - Ihr ökologisches Planungsinstrument,” 2021)
Quantity	smaller urban unit - neighbourhood	Combining large scale and small-scale data (existing land use); including all GS (public and private)	Not directly; addressed as wellbeing and health; not focused on public GS	Green space indicator (Mitchell et al., 2011)
Quantity	part of the city; city level	proportion of green spaces (general), built-up area and population density in each part of the city	Not directly; proportions in different the areas on all green spaces, not focused on public GS	Green space indicators in a social-ecological system (Verma et al., 2020)
Quantity (size) Accessibility (distance)	smaller urban unit - neighbourhood	Use of 2 size categories of public open space (smaller and larger than 1,5ha); Distances to points (stations, services, GS etc.) in relation to the existing network	Addresses walkability to all public spaces; not directly on location/planning adoptable results	Spatial indicators of urban design and transport features (Boeing et al., 2022)
Quantity Accessibility / distribution Quality	General and local level	Combining land use, quality of space (high vegetation and soil permeability); accessibility and shapes of GS	Addresses green spaces in general; different aspects and focused on public GS	Indicators for GS in contrasting urban settings (de la Barrera et al., 2016)
Natural elements / vegetation	Adaptable scale	vegetation cover layers by area, water bodies excluded	Not directly; can be used as a complementary measure of spatial quality	Vegetation indicators NDVI (Tucker, 1979); GRVI (Sripada et al., 2006); SAVI (Huete, 1988)
Natural elements	smaller urban unit - neighbourhood	amount of vegetation and its characterization and neighbourhood types also on height of buildings	Study indirectly addresses social aspects	Urban Neighbourhood Green Index (Gupta et al., 2012)

Table 1: An overview of studied indicators for green spaces in relation to the provision aspects addressing green spaces to promote physical activity.

5 DISCUSSION AND CONCLUSION

The performed reviews of selected literature indicate that criteria for determining appropriate and feasible green space provision indicators is inconsistent, which is also reflected in the practical implementation of indicators, as some of the inspected practical examples have shown. Guided by our objective to develop a spatially explicit indicator, useful for the assessment of green space provision for physical activity in Slovenian settlements, we discuss the two most important findings for our forthcoming work. First is the importance of integrating a variety of parameters in an indicator, second is paying attention to the performance of an indicator at different scales. This also relates to appropriateness of an indicator to be implemented at different spatial planning levels.

With regard to integration of different parameters, existing green space indicators are based on both research and international commitments, but the focus is mostly on environmentally and ecologically measurable

parameters of green spaces, with less attention paid to their social and health benefits that are more difficult to measure, as already highlighted in a 2012 study (Gupta et al., 2012). Often, data is derived from remote sensing imagery and has been used in various studies to differentiate between areas with vegetation and areas without vegetation. Such an approach, however, does not provide any information on accessibility, density of built-up areas and other characteristics of green spaces. It is important to take into consideration that only a fraction of green spaces in cities are publicly accessible and available for active use. We contend that it is due to the complexity by which spatial quality is defined and should be considered, that the existing methods of assessing quality of green spaces for diverse forms of physical activity tend to focus on single parameters, lacking integrated approach towards defining the provision of green spaces to promote physical activity. Accordingly, a solid spatially explicit indicator for assessing the provision of settlements with green spaces for physical activity is non-existent.

With regard to scale, the local level is of particular importance for the calculation of the provision of public green spaces to support physical activity. In general, not enough indicators are developed for small-scale areas such as cities and neighbourhoods, in comparison to large areas such as nations or states, which was also highlighted in a review by Rothenberg et al.(2015).However, locally developed tool which takes into account local conditions and local needs may increase its acceptability(E. Innes and Booher, 2000; Rothenberg et al., 2015).We contend that a spatially explicit indicator should address the provision of a sufficiently generalized yet locally applicable level. The development of providing an indicator further emphasizes the importance of spatially explicit conditions for physical activity. However, it is essential to incorporate relevant, reliable, and verifiable data at the local level to address the specific characteristics of each area. With this in mind, we developed the baseline criteria for each aspect of providing and interconnecting different aspects in evaluating public open spaces, as follows:

(1) Public accessibility: The criteria include proximity, with the requirement of having a public green space of over 500 m² within a walking distance of 300 m or 5 minutes, and an urban park within a walking distance of 900 m or 15 minutes in cities. Design considerations should ensure universal access, while taking into account public accessibility and the impact of topography.

(2) Quantity: The criteria focus on the size of urban parks, which should be a minimum of 1 hectare and located within 900 m of residential areas. The provision should also offer a variety of choices and typologies to cater for diverse user preferences.

(3) Distribution, coherence, and continuity: These criteria consider the spatial arrangement of green spaces in relation to larger and smaller spatial units. The distribution should ensure a coherent and connected network of green spaces, allowing for continuity and seamless access throughout the area.

(4) Attractiveness: The criteria highlight the importance of greenery and canopy cover, aiming to create visually appealing and inviting spaces for the public.

These baseline criteria will serve as a foundation for evaluating and planning the provision of green spaces in the continuation of the project.

We can summarise that the criteria for examining each aspect shall be defined in relation to the desired achievement of the objective of green space provision to promote physical activity of the population and their applicability. The criteria can be qualitative or quantitative. In our study, we took the spatial-planning approach to provision, grouped in three physical activity types according to the way and purpose of space use. As a result, we developed a framework for a green space provision indicator that is spatially explicit and enables the comparison between settlements. This indicator allows for the identification and assessment of green spaces within settlements which comprise three types of physical activities: space-specific activities, distance-specific/long-distance activities, and physical activities as a means of travel.

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