

# Thailand Environmental and Policy Level Physical Activity Interventions: A Critical Review

Titiporn Tuangratananon\*

Thitikorn Topothai†

Chompoonut Topothai†

Viroj Tangcharoensathien†

Corresponding author: Titiporn Tuangratananon

## Abstract

Increasing physical activity brings various benefits, not only preventing premature mortality and saving health care expenditure from non-communicable diseases, but also strengthening social solidarity, reducing social inequity, and improving quality of life. Environmental and policy-level interventions for physical activity are promising population-level interventions, however, the number of studies on those interventions were limited in the lower- and middle-income countries. Therefore, this study aimed to assess the existing environmental and policy interventions in Thailand for the future direction of the intervention design and development. A systematic scoping review was conducted in the primary databases (PubMed, Scopus, and Web of Science) and domestic secondary databases. To gain more understanding of the local context, 77 provincial administrative organizations' strategic plans were further retrieved and analyzed by using the critical interpretative synthesis method. From the systematic review, 11 out of 1,681 studies were included. The results found that evidence on the active environment and active policy physical activity interventions in Thailand were limited in number and diversity, and were rather in sports facilities than physical activity. Infrastructures and urban planning for active transport

\* Bureau of Health Promotion, Department of Health, Ministry of Public Health

† International Health Policy Program, Ministry of Public Health

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were seen as a significant facilitating element by adults, while recreational amenities were the most essential factor in improving the elderly's quality of life. At the local level, only nine provinces out of 77 invested in bicycle pathways, and 16 provinces invested in green spaces, while 42 provinces focused on sports facilities. Policy communication and translation at the local level on a comprehensive concept of physical activity, a collaborative platform between the Ministry of Public Health and Ministry of Interior to provide physical activity implementation, public communication, and routine policy evaluation should be prioritized. Further studies on physical activity policy designs for specific age groups of people were recommended.

**Keywords:** physical activity, environment, policy, Thailand, review

## การส่งเสริมกิจกรรมทางกายในระดับสิ่งแวดล้อมและนโยบายในประเทศไทย: การทบทวนเชิงวิเคราะห์

ฐิติภรณ์ ตวงรัตนานนท์\*, ฐิติกร โตโพธิ์ไทย†, ชมพูนุท โตโพธิ์ไทย†, วิโรจน์ ตั้งเจริญเสถียร†

\* สำนักส่งเสริมสุขภาพ กรมอนามัย กระทรวงสาธารณสุข

† สำนักงานพัฒนาโยบายสุขภาพระหว่างประเทศ กระทรวงสาธารณสุข

ผู้รับผิดชอบบทความ: ฐิติภรณ์ ตวงรัตนานนท์, Titiporn@ihpp.thaigov.net

### บทคัดย่อ

การมีกิจกรรมทางกายที่เพิ่มขึ้นก่อให้เกิดประโยชน์อย่างมาก โดยไม่เพียงลดการเสียชีวิตก่อนวัยอันควรและลดค่าใช้จ่ายในการรักษาพยาบาลจากโรคไม่ติดต่อ แต่ยังส่งผลต่อการสร้างสังคมที่เข้มแข็ง ลดความเหลื่อมล้ำในสังคมและเพิ่มคุณภาพชีวิต การส่งเสริมการมีกิจกรรมทางกายในระดับสิ่งแวดล้อมและนโยบายถือเป็นแนวทางในการเพิ่มกิจกรรมทางกายในระดับประชากรที่มีศักยภาพ อย่างไรก็ตาม งานวิจัยดังกล่าวยังมีจำกัด โดยเฉพาะในกลุ่มประเทศที่มีรายได้ต่ำและปานกลาง การศึกษานี้ มีวัตถุประสงค์เพื่อประเมินการส่งเสริมกิจกรรมทางกายในระดับสิ่งแวดล้อมและนโยบาย เพื่อเป็นแนวทางในการพัฒนาการส่งเสริมกิจกรรมทางกายในประเทศไทย ด้วยการทบทวนวรรณกรรมอย่างเป็นระบบจากฐานข้อมูล ได้แก่ PubMed, Scopus, Web of Science รวมถึงฐานข้อมูลในประเทศ และแผนพัฒนาองค์การบริหารส่วนจังหวัด 77 จังหวัด โดยใช้การทบทวนวรรณกรรมเชิงวิเคราะห์ โดยคัดเลือกเหลือ 11 การศึกษามาวิเคราะห์จาก 1,681 การศึกษา ผลการศึกษาพบว่า หลักฐานเชิงประจักษ์เรื่องการส่งเสริมกิจกรรมทางกายด้านสิ่งแวดล้อมและนโยบายในประเทศไทยยังมีข้อจำกัดในด้านจำนวนและความหลากหลาย โดยการส่งเสริมมุ่งเน้นที่การสนับสนุนสถานที่เพื่อเล่นกีฬามากกว่าเพื่อกิจกรรมทางกาย ประชากรวัยผู้ใหญ่ให้ความสำคัญการส่งเสริมโครงสร้างพื้นฐานและการผังเมือง ในขณะที่ผู้สูงอายุให้ความสำคัญกับสถานที่สำหรับกิจกรรมนันทนาการในระดับพื้นที่ พบว่า 9 จาก 77 จังหวัดสนับสนุนการสร้างทางจักรยาน 16 จังหวัดสนับสนุนการสร้างพื้นที่สีเขียว ในขณะที่ 42 จังหวัดสนับสนุนสถานที่เล่นกีฬา การสื่อสารและสนับสนุนการนำนโยบายส่งเสริมกิจกรรมทางกายไปปฏิบัติในพื้นที่ กลไกการสร้างความร่วมมือระหว่างกระทรวงสาธารณสุขและกระทรวงมหาดไทย การสื่อสารสาธารณะและการประเมินนโยบายอย่างต่อเนื่อง เหล่านี้เป็นประเด็นที่ควรให้ความสำคัญ รวมถึงการศึกษาในอนาคตควรมุ่งเน้นเรื่องการประเมินนโยบายส่งเสริมกิจกรรมทางกายในแต่ละกลุ่มวัยด้วย

**คำสำคัญ:** กิจกรรมทางกาย, สิ่งแวดล้อม, นโยบาย, ประเทศไทย, การทบทวนวรรณกรรม

### Background and Rationale

Physical inactivity has a significant worldwide economic cost<sup>(1,2)</sup>. Physical inactivity increases the risk of a variety of health problems, including major non-communicable diseases such as coronary heart disease, strokes, type 2 diabetes, breast and colon cancers.<sup>(3,4)</sup> Physical inactivity accounted for 75% of DALYs in the low- and middle-income countries and cost USD 53.8 billion.<sup>(1)</sup> The largest global surveillance of physical activity published in 2016 found that 27.5% of adults were physically inactive.<sup>(5)</sup> Increasing physical activity brings various benefits not only saving premature mortality and health care expenditure, but also strengthening social solidarity, reducing social inequity, and im-

proving quality of life through fairness to public transport, access to the recreational park, and good air quality.<sup>(6-9)</sup>

To promote physical activity, the socio-ecological model of physical activity published by Sallis et al. identified multiple physical activity determinants including individual, interpersonal, social, environmental, and policy levels<sup>(10)</sup> – as shown in Figure 1. The built environment including a mix of land uses, connectivity, population density, and general neighborhood design, all played a role in physical activity by increasing daily life movements.<sup>(11-13)</sup> Moreover, the built environment including the infrastructure reconstruction such as street lightings, pavement, bicycle lanes, intersec-

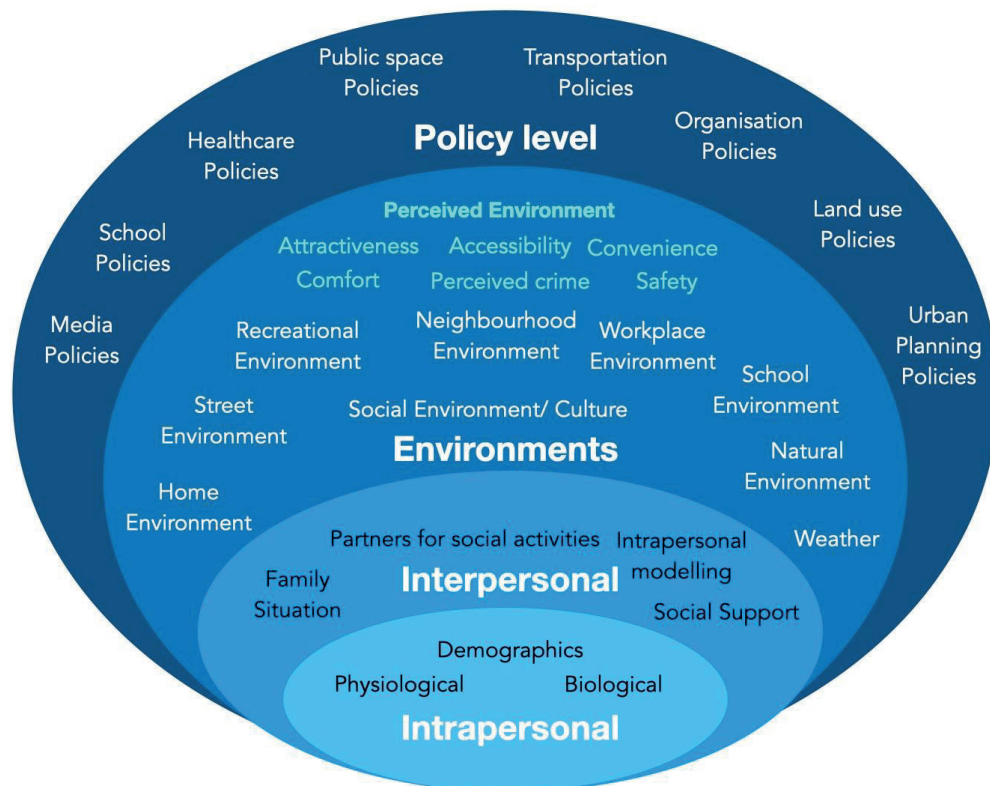


Figure 1 Ecological model of four domains of active living [adapted from Sallis et al. (2006)]<sup>(10)</sup>



tions, traffic calming, and street aesthetic significantly improved physical activity.<sup>(14-17)</sup> In support of adequate environmental interventions, policy interventions such as public space policy, urban planning policy, school policy, etc, are needed to set a vision which prioritizes the promotion of physical activity and engages a multiple stakeholders from various sectors at all levels.<sup>(9,18,19)</sup> Therefore, the contribution of environment and policy to a higher physical activity level in a population is important.

Thailand, an upper middle-income country in the Southeast Asia region with a 70-million population of 77 provinces<sup>(20)</sup>, tasked the Ministry of Public Health for health promotion. However, as health promotion is closely linked to social determinants of health, there is a strong need for the Ministry of Public Health to collaborate with other non-health sectors especially for built environments and policies for physical activity. According to the Decentralization Law<sup>(21)</sup>, health promoting tasks including physical activity promotion at the local levels are in the hands of local government units. The provincial administrative organization is a unit under the Ministry of Interior with the mandate to ensure policy coherences at provincial level by commanding, supporting and communicating with district and subdistrict levels. Environment and policy interventions to promote physical activity can be established at the local

level due to the decentralization. Therefore, an elaboration of effective multi-sectoral collaboration to strengthen the environmental and policy level physical activity interventions by the provincial administrative organization (PAO) is essential.

Although Thailand has promoted physical activity for many decades, only 42% of Thai adults reached the sufficient physical activity level.<sup>(22)</sup> Moreover, many physical activity promoting initiatives and public campaigns were focused on educating people to be more physically active without much emphasizing on environmental and policy level physical activity interventions.<sup>(18,23-25)</sup> In 2018, Liangruenrom et al. conducted a systematic scoping review and found that the number of Thai articles published on physical activity were increasing, particularly focusing on the individual-level interventions, while environmental and policy level physical activity interventions were relatively neglected.<sup>(26)</sup> For physical activity promotion to be sustainable, a detailed understanding of existing environmental and policy interventions was required. Therefore, the goal of this research was to explore environmental and policy-level interventions linked to physical activity that had been implemented in Thailand, as well as to identify potential practice and research gaps that provided additional insights for policy recommendations.

## Methodology

### Study Design

The study design was based on the systematic scoping review and critical interpretative synthesis approach. The critical interpretative synthesis method offers comprehensive and critical appraisal synthesis style as it involves purposive sampling technique to identify known relevant literatures.<sup>(27)</sup> The combination of systems approach will enhance a holistic understanding on environmental and policy level physical activity interventions.

### Data collection

The literature search was conducted in the online international databases (PubMed, Scopus, Web of Science, and the reference lists of all articles selected in the primary search) and domestic databases. Keywords of the literature search were listed as follows; (1) level of interventions: environmental, policy, (2) [OR] environmental interventions: built environment, physical environment, residential density, street connectivity, street aesthetic, land use mixed, (3) [OR] policy interventions: policy, strategy, campaign, programme, action plan, strategic plan, multisectoral, (4) [OR] urban: urban planning, traffic, safety, (5) [AND] physical activity: physical activity, walking, cycling, active transport, public transport, exercise, sports, (6) [AND] population: adult, working age, (7) [AND]

study design: randomised controlled trial, natural experiment, system approach, critical interpretative data were prioritised based on the hierarchy of evidence. The grey literatures such as report and government documents were also included in the literature review section. The documents without the outcome evaluation were included with remarks – see Table 1.

The keywords of the search were included in the title, the abstract, and the keywords of the publications. The manual reference search was collected accordingly. The inclusion criteria of the search were; (1) physical activity interventions targeted any population group living in Thailand, (2) physical activity interventions related to environmental or policy level, (3) presented quantitative or qualitative data relevant to public health, including but not limited to the levels, prevalence, correlates, determinant, or outcomes of engagement in physical activity, (4) described the development or performed an evaluation of a physical activity measurement tool or intervention (5) written in Thai or English, and (6) published after September 2016 to 2019, which followed the search period of a scoping review conducted by Liangruenrom et al.<sup>(26)</sup> While the exclusion criteria were; (1) targeting non-Thai populations, (2) primary outcome(s) focusing on sports/exercise performance or physical therapy, and (3) focusing on children or adolescent.

Table 1 Search keywords

Search keywords used for physical activity	Search keywords used for physical environment and policy	Keywords for Thailand setting
<ul style="list-style-type: none"> <li>• “physical activity”</li> <li>• “physical inactivity”</li> <li>• “physically inactive”</li> <li>• “physical fitness”</li> <li>• “energy expenditure”</li> <li>• “exercise”</li> <li>• “Sport*”</li> <li>• “Gym”</li> <li>• “motor activity”</li> <li>• “Walk*”</li> <li>• “Cycling”</li> <li>• “Stair*”</li> <li>• “active travel”</li> <li>• “active transport”</li> <li>• “lifestyle”</li> <li>• “strength training”</li> <li>• “resistance training”</li> <li>• “weight training”</li> <li>• “weightlifting”</li> <li>• “weight bearing”</li> <li>• “muscle strengthening”</li> <li>• “muscular strengthening”</li> <li>• “muscle training”</li> <li>• “muscle toning”</li> <li>• “strength or toning”</li> </ul>	<ul style="list-style-type: none"> <li>• “environment”</li> <li>• “built environment”</li> <li>• “physical environment”</li> <li>• urban*</li> <li>• “public transport”</li> <li>• “traffic”</li> <li>• “accessibility”</li> <li>• “residential density”</li> <li>• “land use mix”</li> <li>• “street connectivity”</li> <li>• “street aesthetic”</li> <li>• “safety”</li> <li>• “policy”</li> <li>• “action plan”</li> <li>• “program*”</li> <li>• “strategy*”</li> <li>• “campaign*”</li> </ul>	<ul style="list-style-type: none"> <li>• กิจกรรมทางกาย</li> <li>• ออกกำลังกาย</li> <li>• นี้อยิ่ง</li> <li>• พลังงาน</li> <li>• กล้ามเนื้อ</li> <li>• กีฬา</li> <li>• ฟิตเนส</li> <li>• จักรยาน</li> <li>• วิ่ง</li> <li>• เดิน</li> <li>• เดินทาง</li> <li>• ยกน้ำหนัก</li> <li>• ความอ่อนตัว</li> <li>• สิ่งแวดล้อม</li> <li>• ผังเมือง</li> <li>• จราจร</li> <li>•ขนส่งสาธารณะ</li> <li>• สวนสาธารณะ</li> <li>• สนามเด็กเล่น</li> <li>• ความปลอดภัย</li> <li>• นโยบาย</li> <li>• สาธารณะ</li> <li>• แผนปฏิบัติการ</li> <li>• กลยุทธ์</li> <li>• โครงการ</li> <li>• แคมเปญ</li> </ul>

Most domestic literatures were collected from domestic databases such as Journal of Health Systems Research, Division of Physical Activity, Ministry of Public Health, Thai Health Promotion Foundation, Physical Activity Research Centre, Thai Non-communicable Diseases Network, Thai National Research Repository, and Thai Thesis

Database. The Journal of Health Systems Research situated in the Health Systems Research Institute (HSRI). The institute’s mission is prioritizing and serving as public health and health systems publications and acts as health systems research manager in Thailand. Manual search of references in Journal of Health Systems Research database

was performed. The inclusion of PAO data was retrieved separately. The strategic plans in 77 PAOs in Thailand related to environmental and policy physical activity intervention were also retrieved through their official websites for public access based on transparency principle.

### Data Extraction

All references from the search results were imported to Mendeley software. Duplicates were deleted and abstract screening for inclusion and exclusion criteria were carried out. Data extraction form was specifically designed and utilized. The form included the following publication details; (1) general information: author names, year of publication, publication type (international publication, domestic publication, and grey literature), and full text language, (2) publication: type of study design, research methods, and sample size, (3) grey literature types: report and indicators, (4) intervention setting: national, provincial, district, subdistrict, (5) results (if applicable): outcomes related to physical activity, evaluation process and results, (6) potential implications, and (7) limitations.

Quality analysis of the included research was assessed by the Mixed Method Appraisal Tool (MMAT) 2018.<sup>(28)</sup> The MMAT 2018 was designed for the systematic mixed-method studies to evaluate the quality of qualitative, quantitative, and mixed-method study - see Table 2. The tool was divided into six sections according to each research design, namely, (1) Screening questions (two questions), (2) Qualitative, (3) Quantitative

randomized controlled trials, (4) Quantitative non-randomized, (5) Quantitative descriptive, (6) Mixed-methods, which consists of five questions under each study design type. Responses of the MMAT questions are ‘yes’, ‘no’, and ‘can’t tell’. Therefore, the total score for each study design would be seven and the higher score represents higher quality study. Although the MMAT criteria do not contain sufficient details in each study design, it provides the opportunity to compare quality of the study between study designs.

Data were prioritized based on the hierarchy of evidence. A higher hierarchy of research including systematic reviews and randomized controlled trials and a lower hierarchy of natural experiment or cross-sectional study were identified under the following criteria: 1) The interventions include environmental or policy level physical activity interventions. 2) The interventions focus on adults or general population. The grey literatures such as report and government documents were also included in the literature review section. The documents without the outcome evaluation were included with remarks.

### Data Analysis

The data analysis followed the critical interpretative synthesis method, which based on the meta-ethnography with some modifications.<sup>(14)</sup> The comparison of similarities and differences in the collected interventions were synthesised. The descriptive analysis was carried out in the first place followed by the line of argument from the observations. The ultimate outcome from the



Table 2 Summary of quality assessment by Mixed-Method Appraisal Tool 2018<sup>(28)</sup>

Study designs	Chand rasiri and Arifwidodo (2017) <sup>(36)</sup>	Chaysuk and Wethy avivorn (2017) <sup>(34)</sup>	Detphi chai and Phong athich art (2017) <sup>(35)</sup>	Kaew klueng klom et al. (2017) <sup>(38)</sup>	Kongsri (2017) <sup>(32)</sup>	Rueng tam (2017) <sup>(30)</sup>	Rutirako (2017) <sup>(33)</sup>	Termk hun thod (2017) <sup>(37)</sup>	Tiraphat et al. (2017) <sup>(29)</sup>	Tuang ratana non et al. (2018) <sup>(31)</sup>	Kham put et al. (2019) <sup>(19)</sup>
1. Are there clear research questions?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
2. Do the collected data allow to address the research questions?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
<b>Qualitative</b>											
1. Is the qualitative approach appropriate to answer the research question?					yes					yes	yes
2. Are the qualitative data collection methods adequate to address the research question?					yes					yes	yes
3. Are the findings adequately derived from the data?					no					yes	yes
4. Is the interpretation of results sufficiently substantiated by data?					no					no	no
5. Is there coherence between qualitative data sources, collection, analysis and interpretation?					yes					yes	yes
<b>Quantitative nonrandomized</b>											
1. Are the participants represent the target population?	yes	yes	yes	yes		no		yes	yes		
2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	yes	yes	yes	yes		yes		yes	yes		
3. Are there complete outcome data?	yes	no	yes	no		yes		no	yes		
4. Are the confounders accounted for in the design and analysis?	no	no	yes	yes		yes		no	yes		
5. During the study period, is the intervention administered yes (or exposure occurred) as intended?	yes	yes	yes		yes		yes	yes			



Table 2 Summary of quality assessment by Mixed-Method Appraisal Tool 2018<sup>(28)</sup> (cont.)

Study designs	Chandrasiri and Arifwidodo (2017) <sup>(36)</sup>	Chaysuk and Wethy avivorn (2017) <sup>(34)</sup>	Detphichai and Phongathichart (2017) <sup>(35)</sup>	Kaewklom et al. (2017) <sup>(38)</sup>	Kongsri (2017) <sup>(32)</sup>	Ruengtam (2017) <sup>(30)</sup>	Rutirako (2017) <sup>(33)</sup>	Termhuthod (2017) <sup>(37)</sup>	Tiraphat et al. (2017) <sup>(29)</sup>	Tuangratana et al. (2018) <sup>(31)</sup>	Khamput et al. (2019) <sup>(19)</sup>
<b>Mixed-methods</b>											
1. Is there an adequate rationale for using a mixed methods design to address the research question?							yes				
2. Are the different components of the study effectively integrated to answer the research question?							yes				
3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?							no				
4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?							no				
5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?							yes				
Percentage of 'Yes'	85.71	71.43	100.00	85.71	71.43	85.71	71.43	71.43	100.00	85.71	85.71

data analysis was new conceptual frameworks and synthetic constructs resulted from the collected data related to the environmental and policy level physical activity interventions.<sup>(27)</sup> The analysis process started from a thorough review of the included articles/literatures. Possible categories and themes were developed from the data, followed by the conceptual framework. Descriptive quantitative analysis such as the summation of the articles, percent, and frequency was carried

out as appropriate.

## Results

### Literature Search

A total of 1,707 publications were retrieved after searching three international databases (PubMed, Web of Science, and Scopus), with an additional 177 articles identified by searching seven domestic databases. There were 1,681

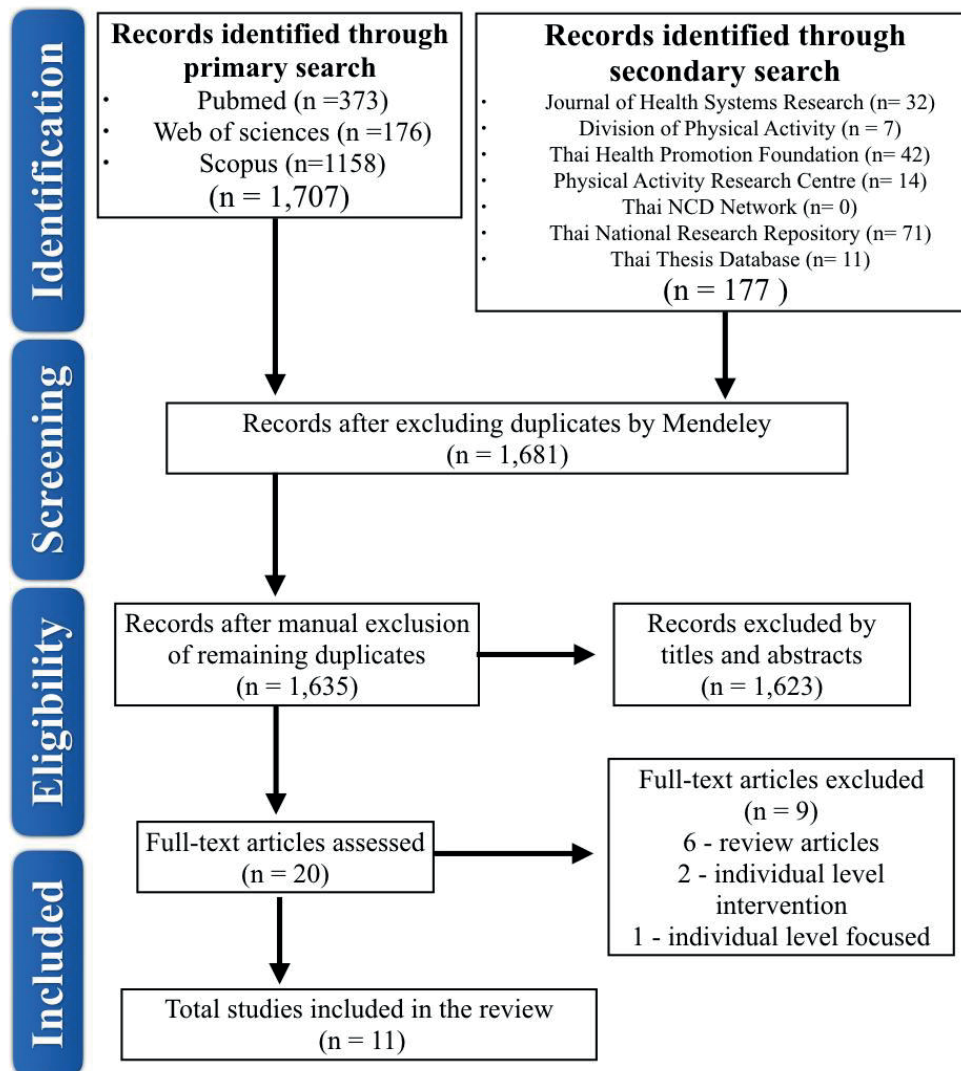


Figure 2 Flow diagram of article selection process

articles left after removing duplicates with Mendeley tools. Further manual duplicate removal was performed. The remaining publications' titles and abstracts were assessed against the inclusion and exclusion criteria. The full text of 20 articles were then obtained and evaluated for eligibility. The 11 publications that were selected for the scoping review – as shown in Figure 2.

The scope of the search was expanded in the second round to include three-year strategic

plans from the 77 PAOs. These data were manually identified on the websites of each PAO. The three-year strategic plan covered all aspects of citizen quality of life in general (economics, environment, social, infrastructure, cultural and arts, and management). The focus of this analysis, however, was on environmental and policy interventions in physical activity, which were often found in the health, infrastructure, cultural and sports, and policy initiatives – as illustrated in Figure 3.

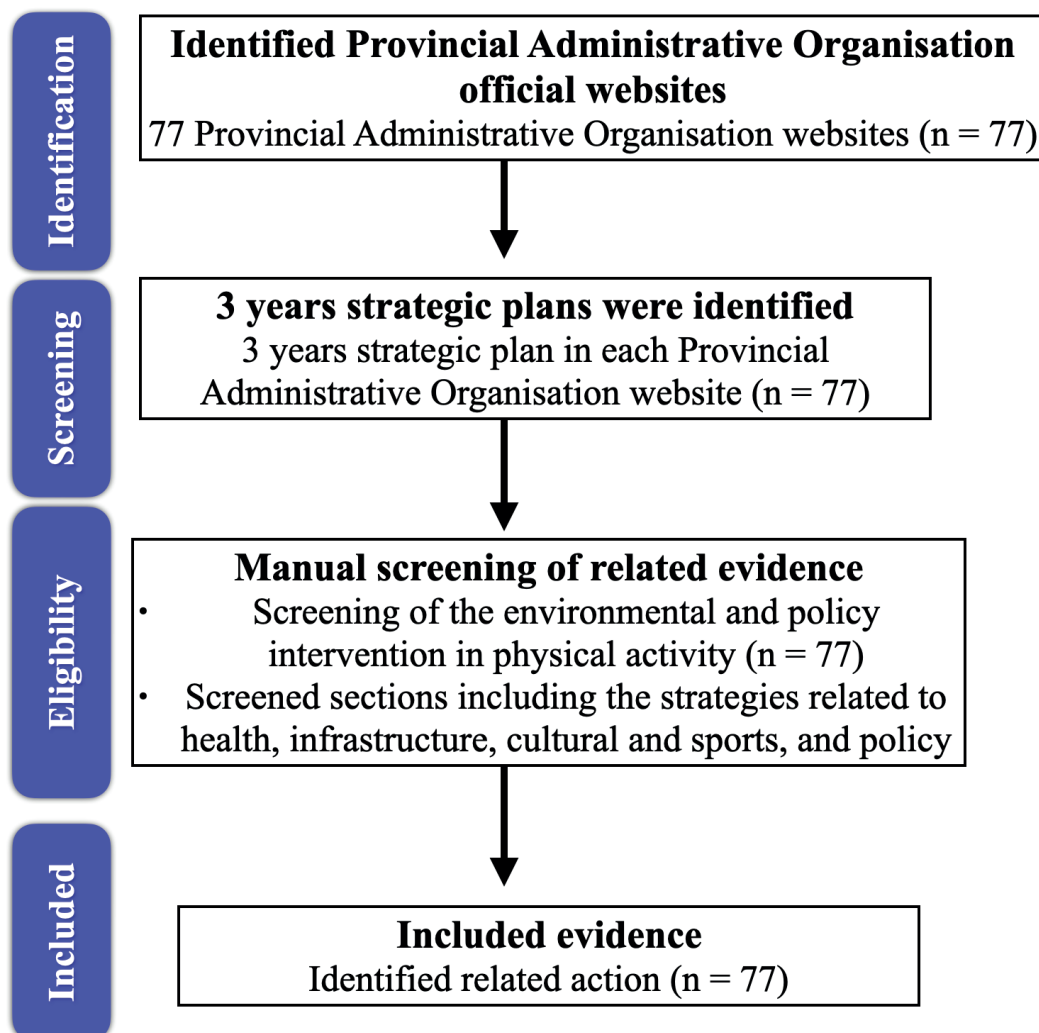


Figure 3 Flow diagram of the Provincial Administrative Organization search selection process



### Characteristics of the included studies

Table 3 summarized the characteristics of 11 articles. Only three research studies used qualitative methods, and the majority of the publications (7 out of 11) used a cross-sectional design. Questionnaires were the only data collection tool employed in the quantitative investigations. Four publications were published in peer-reviewed international journals. The largest number of participants in the quantitative research was 4,183,<sup>(29)</sup> while the smallest number of participants was 206.<sup>(36)</sup> There were two studies produced by academics and two studies performed by government entities. The intervention settings were evenly divided across country (2 studies), province (2 studies), district (2 studies), and sub-district (2 studies), with two studies conducted at each of provincial, district, and subdistrict levels.<sup>(19,31)</sup>

To assess the quality of each study, the MMAT 2018 criteria were examined.<sup>(28)</sup> The studies were of moderate to high quality overall. Five out of seven items received the lowest score, while the total seven points received the highest (see Table 2). Two of the three qualitative investigations scored 85.7% with the same limitation: poor interpretation of the data collected.<sup>(19,31)</sup> Another qualitative research (71.4%) rated one point lower.<sup>(32)</sup> Similarly, Rutirako's mixed-method study received the lowest score due to data incoherence between quantitative and qualitative data.<sup>(33)</sup> The seven cross-sectional studies in this study received scores ranging from 71.4% to 100%, with an average of 85.7%.

### Active environment

As illustrated in a number of the included articles, cycling, and walking infrastructure was perceived as key aspects in promoting higher levels of physical activity.<sup>(32-35)</sup> Without the presence of a bike lane or pavement, the offer of free bicycles alone would not be sufficient to boost active transport among university students. Even though there were plenty of free bicycles available, just 2.6% of university students commuted by bicycle.<sup>(34)</sup> Students emphasized the importance of a bicycle lane, street lights, reduced footpath incursions, and bicycle parking spaces in encouraging them to commute by bicycle.<sup>(34)</sup> The installation of bicycle lanes, pavements, bicycle parking, and road shelters was found to be essential, but insufficient.<sup>(32,33)</sup> These findings were endorsed by Khamput et al., who found that active transportation infrastructure received less investment than sports facilities or equipment.<sup>(19)</sup>

Pavement, bike lanes, and street connectedness, on the other hand, were not listed as major factors in increasing physical activity among elders in research that focused on them.<sup>(29,30)</sup> Over the pavements or cycling lane, the elders recognized the need for a fitness center, swimming pool, outdoor stadium, indoor activities, and a garden and outdoor area.<sup>(30)</sup> Furthermore, elders who lived in more supportive surroundings had a higher quality of life than those who lived in less supportive environments (OR 3.79; % CI 3.30-4.37, *p*-value 0.001).<sup>(29)</sup> The presence of green areas in the community was regarded as a critical component in promoting physical activity across the

Table 3 Summary of included academic literatures

Author, year	Study type	Methods			Document Setting	Results	Potential Implication	Limitations
		Study design	Research Tools	Sample size				
Chandrasiri and Arifwidodo, 2017 <sup>(36)</sup>	Int. Pub	Cross-sectional	Direct observation and questionnaire	206	Subdistrict	<ul style="list-style-type: none"> <li>- The average number of park user is 2,663 per day, about 46.2% perform moderate-to-vigorous physical activity and 43.1 % perform light physical activity.</li> <li>- Majority of MVPA park users is adults (72.4%), who are office workers.</li> <li>- Accessibility, safety and organized activities received satisfied scores from the users, aesthetic received lower score.</li> </ul>	Evidence reported the physical activity benefits from green spaces as they could support public spaces development in the urban areas.	<ol style="list-style-type: none"> <li>1) Self-reported questionnaire may lead to reporting bias.</li> <li>2) There is a chance of sampling bias as the study site is one of the most crowded parks in Bangkok.</li> </ol>
Chaysuk and Wethyavivorn, 2017 <sup>(34)</sup>	Conf.	Cross-sectional	Questionnaire	400	Institute	<ul style="list-style-type: none"> <li>- The availability of free university bicycle is not a single factor to encourage students to cycle in the campus.</li> <li>- Majority of the students choose walking (41.89%), motorcycle taxi (30.28%), university shuttle van (25.22%), and cycling (2.61%) when transferring in the campus.</li> <li>- The main reasons for choosing bicycle are budget saving, health benefits, and convenience.</li> <li>- Students emphasis on the needs of bicycle lane, street-lighting, footpath invasion management, and bike parking space.</li> </ul>	Bike lane and street-lighting are essential especially when road safety is listed among top concern. The low rate of cyclists exists regardless of the availability of the bicycles, which reflects the needs of supporting infrastructures and policies.	<ol style="list-style-type: none"> <li>1) Self-reported questionnaire may lead to reporting bias.</li> <li>2) Close-ended questions may not reveal actual reasons behind the low rate of cycling among students.</li> </ol>



Table 3 Summary of included academic literatures (cont.)

Author, year	Study type	Methods			Document Setting	Results	Potential Implication	Limitations
		Study design	Research Tools	Sample size				
Detphichai and Phongathichart, 2017 <sup>(35)</sup>	Conf.	Cross-sectional	Questionnaire	400	Subdistrict	<ul style="list-style-type: none"> <li>- The number of participants who normally commute by cycling or walking to destinations is only 2.75%, whereas 12.75% walk and 1.75% cycle to take the sky-train.</li> <li>- Road safety and personal safety is among participants concerns (23.75%).</li> <li>- Approximately half of the commuters (47.25%) intended to take the sky-train if the pavement/bike lane is fully provided.</li> </ul>	Road safety should be ensured for pedestrians and cyclists in order to promote physical activity. Therefore, pavement or bike lane and supportive infrastructure are needed.	<ol style="list-style-type: none"> <li>1) Self-reported questionnaire may lead to reporting bias.</li> <li>2) The over-interpretation of the results may undermine study's credibility.</li> </ol>
Kaewklueklom et al., 2017 <sup>(38)</sup>	Int. Pub	Cross-sectional	Questionnaire	600	Provincial	<ul style="list-style-type: none"> <li>- Bus Rapid Transit (BRT) is a local public transportation by bus in Khon-Kaen city center.</li> <li>- The measuring by Likert scale (1-5) towards BRT utilization showed the following results: positive attitude (Mean 4.07), perceived behavioral control (Mean 4.00), intention (Mean 3.64), and subjective norm (Mean 3.57) towards BRT utilization.</li> <li>- Participants prefer BRT due to its convenience and low price with the additional of positive social influence.</li> </ul>	The success public transport utilization resulted from positive social norm, which can be improved by the public campaign. Fast and low-cost public transportation also influences people's decision.	<ol style="list-style-type: none"> <li>1) Self-reported questionnaire may lead to reporting bias.</li> <li>2) Socioeconomic background was not analyzed. This limitation could confound the results.</li> </ol>

Table 3 Summary of included academic literatures (cont.)

Author, year	Study type	Methods			Document Setting	Results	Potential Implication	Limitations
		Study design	Research Tools	Sample size				
Kongsri, 2017 <sup>(32)</sup>	Conf.	Qualitative review and secondary data analysis	Literature	N/A	National	- The bicycle infrastructure in Thailand is insufficient. Bicycle lanes and supporting facilities are still low in number throughout the country. Laws and regulations related to the built environments are inadequate and the law enforcement is also inefficient.	Infrastructure development and promote bicycle culture and attitudes of the public should be promoted.	The lack of evidence in urbanization of the city and bicycle usage data lead to incomplete analysis of the situation.
Ruengtam, 2017 <sup>(30)</sup>	Int. Pub	Cross-sectional	Questionnaire	531	District	Factor analysis was performed, top three physical environments that were perceived important among elders are; 1) fitness centre (factor 0.807), 2) swimming pool (factor 0.783), and 3) outdoor stadium (factor 0.682). Pavements and bicycle lanes were not listed as important facilities.	Conducive physical activity environments among elderly mostly are indoor activity such as pavements or bike lanes.	1) Self-reported questionnaire may lead to reporting bias. 2) The convenient non-probability sampling technique could lead to selection bias.
Rutirako, 2017 <sup>(33)</sup>	Conf.	Mixed-method	Direct observation, in-depth interview, and questionnaire	Hat Yai district	District	- The qualitative part reflected that the overall physical activity friendly infrastructure (pavement, disability pavement, road shelter) is insufficient and the existing pavement, bike lane, and crossing-bridge are also invaded by vendors or residents. - The descriptive statistic revealed that the majority of cyclists (72%) encountered accidents while cycling.	The infrastructure improvement and the pavement invasion management should be urgently solved. Society perception related to road safety is still low.	1) No total number of participants was provided. 2) No content validity or credibility of questionnaire or interview guide was provided.

**Table 3** Summary of included academic literatures (cont.)

Author, year	Study type	Methods			Document Setting	Results	Potential Implication	Limitations
		Study design	Research Tools	Sample size				
Termkhunthod, 2017 <sup>(37)</sup>	Conf.	Cross-sectional	Questionnaire	1,200	Provincial	<ul style="list-style-type: none"> <li>- The evaluation was done by the descriptive analysis from Likert scale 1-5.</li> <li>- The satisfactory level from all provinces (Buriram, Surin, and Sisaket) revealed that the obstacles (pavement invasion) and road safety was moderately well managed and the supporting policy were at highly satisfied.</li> </ul>	The satisfaction on supporting policy in walkability was high, whereas actual implementation was still at moderate level.	<ol style="list-style-type: none"> <li>1) Self-reported questionnaire may lead to reporting bias.</li> <li>2) No questionnaire validity and credibility was performed.</li> </ol>
Tiraphat et al., 2017 <sup>(29)</sup>	Int. Pub	Cross-sectional	Questionnaire	4,183	National	<ul style="list-style-type: none"> <li>- Elders who live in friendly environment were more likely to have better quality of life compared to those who lived in less physical activity conducive environment (OR 3.79, <math>p &lt; 0.001</math>).</li> <li>- Built environments that contained high prediction level of quality of life were places for walking, crime safety, accessibility, aesthetics, social trust, and social cohesion.</li> </ul>	Providing a supportive evidence for developing age-friendly built environments that emphasises on infrastructure, crime reduction, and aesthetics.	<ol style="list-style-type: none"> <li>1) Self-reported questionnaire may lead to reporting bias.</li> <li>2) Cross-sectional study cannot provide causal relationship.</li> </ol>
Tuangratananon et al., 2018 <sup>(31)</sup>	Dom. Pub	Qualitative	In depth interview, unstructured observation and	3 levels municipalities	Provincial, District, Subdistrict	<ul style="list-style-type: none"> <li>- Each municipality contained multisectoral sub-units, therefore, the adoption of Health in All Policies was more feasible.</li> <li>- Education, health, social,</li> </ul>	The collaborative works between sectors enhance the physical activity supportive campaigns. The municipalities usually	<ol style="list-style-type: none"> <li>1) There was potential selection bias as only best practice municipalities were recruited.</li> <li>2) Only three municipalities were selected thus</li> </ol>



**Table 3** Summary of included academic literatures (cont.)

Author, year	Study type	Methods			Document Setting	Results	Potential Implication	Limitations
		Study design	Research Tools	Sample size				
			document review			transportation, and housing unit usually worked in collaboration in promoting campaigns or programmes related to physical activity. - Strategic plan and policy implementation in the organization usually worked seamlessly due to leader organisation structure and strong community engagement.	had adequate capacity to conduct physical activity campaign by their own.	representativeness was questionable.
Khamput et al., 2019 <sup>(19)</sup>	Dom. Pub	Qualitative	In depth interview, observation and document review	12 municipalities; 3 levels	Provincial, District, Subdistrict	- All municipalities invested in infrastructures (parks and stadiums) and physical activity clubs. Local cultural festivals or running/ cycling events were also occasionally held. - Facilitating factors included strong leadership, secure funding, strong community engagement, and multi-sectoral collaboration within and beyond organisations.	National or regional authorities should consider the bottom up policy approach and support the local multi-sectoral collaboration.	There was potential selection bias as only best practice municipalities were recruited.

Abbreviations: Conf. - conference proceedings; Dom. Pub - domestic publication; Int. Pub - international publication; MVPA - moderate to vigorous physical activity; SD - standard deviation



research included. Although the majority of park visitors (46.2%) engaged in moderate to vigorous physical activity, a nearly equal number (43.1%) engaged in light physical activity<sup>(36)</sup>, there was no subgroup study based on age differences that could have provided a clearer explanation for the importance of parks to senior citizens.

The most serious concern in active transportation was road safety.<sup>(34,35,37)</sup> The lack of road user discipline was cited as a major barrier to bicycle riding among university students<sup>(34)</sup> and walking/cycling in public transportation in metropolitan areas.<sup>(35,37)</sup> According to two studies, the rate of accidents among cyclists was as high as 72%.<sup>(33)</sup> In other words, the annual rate of bicycle accidents per biker was twice a year.<sup>(35)</sup> However, pedestrians were involved in accidents at a higher rate than bikers (3.48 times per year per pedestrian).<sup>(35)</sup> The negative societal norm and attitude towards walking, cycling and public transport to workplace was another barrier to active transportation, while positive attitude was shown to boost the Bus Rapid Transit (BRT) use in a study by Kaewkluengklom et al.<sup>(38)</sup> This finding was consistent with Thailand's anti-cycling/walking mentality and pro-car culture, which restricted walking and cycling to specific places.<sup>(32)</sup>

### Active policy

Overall, no mention of the policy evaluation process or results was made in any of the studies. Four out of six studies, on the other hand, cited current supportive policies and governance to encourage physical activity.<sup>(19,31,34,37)</sup> Only the

university's own intervention gained long-term financial protection, according to the findings.<sup>(34)</sup> Municipal interventions, on the other hand, were insecure budget, despite significant political support.<sup>(19,31,37)</sup> In terms of multisectoral collaboration, excellent leadership, and community participation, Tuangratananon et al. and Khamput et al. provided examples of effective supporting governance systems.<sup>(19,31)</sup> The findings contrasted with results from two other research, Kongsri and Rutirako both claimed that active travel laws and regulations were ineffective and insufficient. In Thailand, the legislation and regulations governing cyclists and pedestrians were less prominent than those governing car use.<sup>(32,33)</sup> Implementation of policies and rules such as pavement/bike lane invasion prevention, street connectivity, and supporting infrastructures were also required.

### Provincial administrative organizations strategic plan for physical activity

The PAO's three-year strategic plan revealed that each province has various priorities and levels of effort, therefore environmental and policy level interventions in physical activity may differ from each other. In general, physical activity-related measures were not prioritized in the health or sports categories. It was determined that access to healthcare was given a higher priority than preventive and promotion, and sports facilities and the availability of sports equipment were emphasized more than the construction of green and blue areas. Infrastructure development, on the other hand, was traditionally associated with vehicle

road construction rather than pavements or bike lanes. The renovation or construction of sporting facilities was observed across the country - as illustrated in Figure 4. School facilities, on the other hand, were less well-funded and geographically dispersed in the PAO's strategic plan. The majority of the interventions occurred in the central region. Three provinces in the northern (17 provinces) and northern-eastern (20 provinces) regions had created walkability infrastructure, compared to five provinces in the central region (26 provinces). Furthermore, half of the provinces that planned to expand access to green spaces were located in the central region. In the north-eastern region, a similar situation occurred, with only one province out of twenty planning to expand access to green spaces.

## Discussion

In the current study, only eleven research studies on environmental and policy interventions were identified. In addition, six of the eleven studies addressed active policy initiatives. This is in line with the findings of Liangruenrom et al.'s study which found only one active environment study was identified in the study, indicating a scarcity of evidence in active environments and active policy in Thailand.<sup>(26)</sup> Also, similar findings were found by Pratt et al. that eight policies studies out of a total of 95 environmental research and the included policy interventions provide policy concepts and benefits rather than policy evaluation or assessment.<sup>(39)</sup>

In the present study, active infrastructure, as

well as a favorable attitude toward walking and cycling, road safety, and recreational amenities, were considered to be significant, but insufficient. Local governments with a strong political commitment and multisectoral collaboration on physical activity promotion, active transportation policy, and law implementation including policy evaluation were still needed. About half of the PAO's strategic plans included measures concerning active environments, but such particular actions were focused on sports facilities rather than active transportation.

In active travel, different populations reported distinct enabling elements and constraints. Built environments, such as street connections, infrastructure, and land use mix, appeared to be supportive to active transportation.<sup>(40-42)</sup> In contrast, Tiraphat et al. discovered that street connectivity and traffic hazard were not critical variables for elderly when it came to transportation.<sup>(29)</sup> Despite the fact that Tiraphat et al.'s study received a perfect score in the quality evaluation, the causal association between environmental improvements and active transportation was not as strong as a natural experiment or a randomized controlled trial. This conclusion contradicted with Cerin et al.'s systematic review, which found three research studies with positive relationships between perceived street connection and active travel in the elderly.<sup>(43)</sup> Other unobserved factors, such as cultural variety or climate differences, could cause such a disparity. Regardless of country contexts, the perceived benefits of access to parks or recreational facilities were

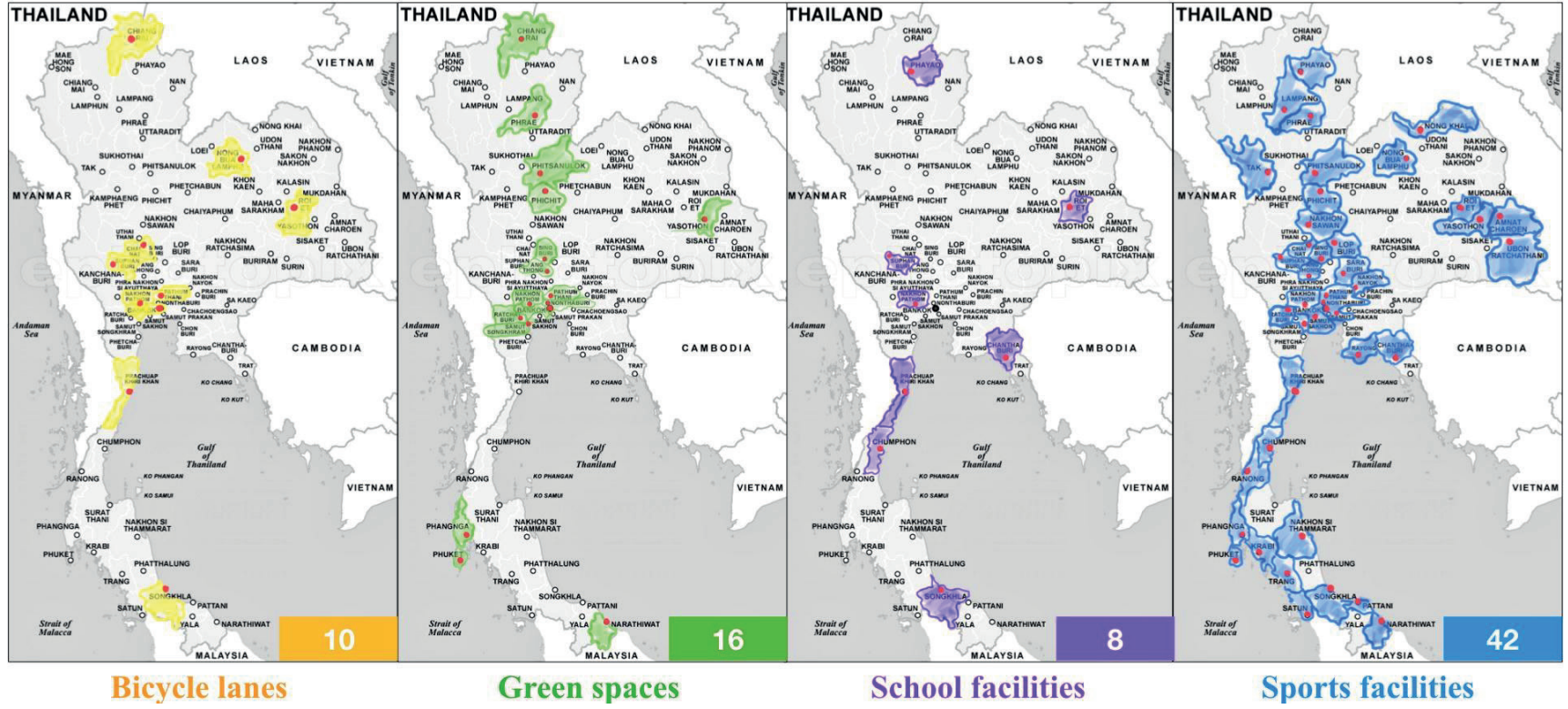


Figure 4 Map of environmental and policy level intervention in physical activity from 77 provincial administrative organizations

positive.<sup>(29,43)</sup> These findings suggested that future studies should include age-specific interventions in order to improve conducive environments.

Transportation and urban policies were significant in supporting active travel as the built environment policy, financial support, and supportive governance structures were found to be important in encouraging active travel in the community.<sup>(42,44)</sup> Street connection and land use mix were critical for promoting active travel, and information about active travel could provide feedback on the comprehensiveness of transportation and urban policy.<sup>(12,13,45)</sup> Although, the Thailand National Physical Activity Strategy stated the need of close collaboration between transportation and urban sectors,<sup>(18)</sup> however, explicit action plan or collaboration platform was not yet established.<sup>(23,46)</sup> The transportation sector mostly focused on improving road conditions rather than pavements or bicycle paths.<sup>(44)</sup> This action could reflect limited collaboration between health and transportation sector.

Various studies found that municipal policies such as constructed infrastructure could support active living.<sup>(12,13,47-51)</sup> This finding was comparable to that of Tuangratananon et al. and Khamput et al., who found that PAO governance was critical.<sup>(19,31)</sup> However, almost half of PAO strategic plans included measures concerning active environments, but the concrete actions were focused on sports facilities rather than pedestrian or bicycle infrastructures. One probable explanation is that the staff of the PAO were more experienced with exercise than physical activity.<sup>(25,51)</sup> As a result, greater research into the perceptions of members

of PAOs is needed.

Policy communication and advocacy at the provincial level is essential, yet the routine policy evaluation at the local level was scarce. None of the included literature mentioned the evaluation of policies on promoting healthy lifestyle. A plausible explanation is that PAOs are obliged to provide annual report to headquarter rather than academic literature.<sup>(8,19,31,52)</sup> Annual report mainly followed annual indicators, which followed national strategy, and it was observed that the implemented actions at the PAO level were not documented in the Thailand National Physical Activity Strategy and vice versa.<sup>(18)</sup> Internationally, the physical activity policy audit tool (PAT) could provide a single platform for physical activity policy evaluation and resulted in more comprehensive policy evaluation.<sup>(9,53,54)</sup> Therefore, further evaluation could follow this tool in order to track the country performance in parallel with the monitoring and evaluation of the National Physical Activity Strategy.

In terms of policy implications, policy communication and translation at the local level should be prioritized in order to scale up active environment and policy interventions in Thailand.<sup>(8,18,19,31,51,52)</sup> The Ministry of Public Health and the Ministry of Interior, for example, should communicate more about the idea of physical activity, particularly when it comes to environmental or policy intervention determinants.<sup>(8,18,19,31,51,52)</sup> A collaboration platform between the Ministry of Public Health and the Ministry of Interior is suggested as a way to achieve a complete phys-



ical activity strategy and a budget and resource balance between investments in sports facilities and walkability infrastructure. To raise population awareness, public communication, including public education and positive social norms related to active transportation, should be carried out.<sup>(51)</sup>

Routine policy review at the provincial level is also required to guide policy development and execution in order to address inequity in terms of population and geographic coverage.<sup>(8,52)</sup>

The study's strengths have been addressed. Firstly, this was one of the first studies to collect data from all available international and domestic sources to conduct a full analysis of domestic environment and policy level physical activity initiatives. The findings of this study could be used to inform future policy development and communication. Second, this was the first study to give a comprehensive picture of physical activity implementation across Thailand's 77 PAOs. However, there were a few limitations. The first was a scarcity of environmental and policy intervention research, both in quantity and quality. Critical analysis was based on only eleven research studies, making it difficult to form a definite conclusion. Furthermore, research quality should be improved by encouraging researchers to use a more rigorous research design rather than cross-sectional methodology. The second research gap was the absence of policy evaluation studies, as this analysis found that none of the literature, including government records, could give evidence of policy evaluation or impact. The paucity of study on various age groups was the

third gap. Adults and the elderly had different perspectives on the availability of infrastructure and recreational facilities, according to the study. The findings of such a study could be useful in the building of urban housing.

## Conclusions

There was a scarcity of literature, particularly in the area of environmental and policy initiatives that promote physical activity in Thailand. Policy evaluation or impact study was not identified from the search. Infrastructures and urban planning for active transport were seen as a significant facilitating element by adults, while recreational amenities were the most essential factor in improving the elderly's quality of life. Only nine provinces out of 77 invested in bicycle pathways, and 16 provinces invested in green spaces, while 42 provinces focused on sports facilities. Policy communication and translation at the local level on a comprehensive concept of physical activity, a collaborative platform between the Ministry of Public Health and Ministry of Interior to provide physical activity implementation, public communication, and routine policy evaluation should be prioritized. Further studies on physical activity policy designs for specific age groups of people were recommended.

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