

5. Physical activity surveillance

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5.1 Introduction – the role of surveillance

Surveillance systems grew out of infectious disease monitoring, to enable early detection and tracking of the progress of epidemic disease. Surveillance is defined as the “(continuous) systematic collection, analysis, and interpretation of data for use in the planning, implementation, and evaluation of public health (programs and) practice”.¹ With the increase in chronic disease in recent decades, surveillance of chronic disease risk factors has become a routine part of public health monitoring.² Optimal physical activity (PA) surveillance needs to assess elements of the *PA system* as well as monitoring the population prevalence of PA. This chapter is linked to [Chapter 1.2](#) on the prevalence of PA and meeting PA guidelines among Australians, with common themes of measurement and monitoring. The focus of this chapter is to describe the measures of PA used in surveillance and elaborate on the broader measurement and monitoring required for an optimal PA surveillance system (PASS). A surveillance system is tied to the specific elements of a national or regional PA plan and includes a range of indicators required to monitor the implementation and outcomes specified in that plan.

5.2 Measures of physical activity

An optimal PASS needs to use standardised protocols and measures. The first step is to assess PA, usually expressed as the proportion of adults or children meeting PA recommendations (see [Chapter 1.2](#)). Traditionally, surveillance systems have used self-report measures, where people are asked to describe their PA participation in a recent period, usually in the past week, past two weeks, or past month.

In designing a PASS, the purpose and type of measurement of PA should be specified: (i) which measure will be used; (ii) has it been validated and used in surveillance systems; and (although rarely considered) (iii) is it sensitive enough to detect changes in population PA. PA is often categorised and assessed by: (i) intensity (e.g. light, moderate, and vigorous); (ii) domain (e.g. work, transport, domestic, and leisure time); and (iii) type (e.g. walking, cycling, running, specific sports).

Measurement can occur across the whole 24-hour spectrum, and can, in addition to measures of PA, also include sitting/sedentary time and sleep (see [Figure 34](#)). Establishing which among these measures are essential for surveillance needs careful consideration, based on the strategic outcomes proposed in the PA plan. These should be monitored consistently for the duration of the PASS; typically, this should be at least 10–20 years (i.e. the time required to expect changes in endpoint PA behaviours at the population level). As described in [Chapter 1.2](#), the PA measure should be identical over time to enable time-trends to be established and should be identical across jurisdictions to enable geographical comparisons.

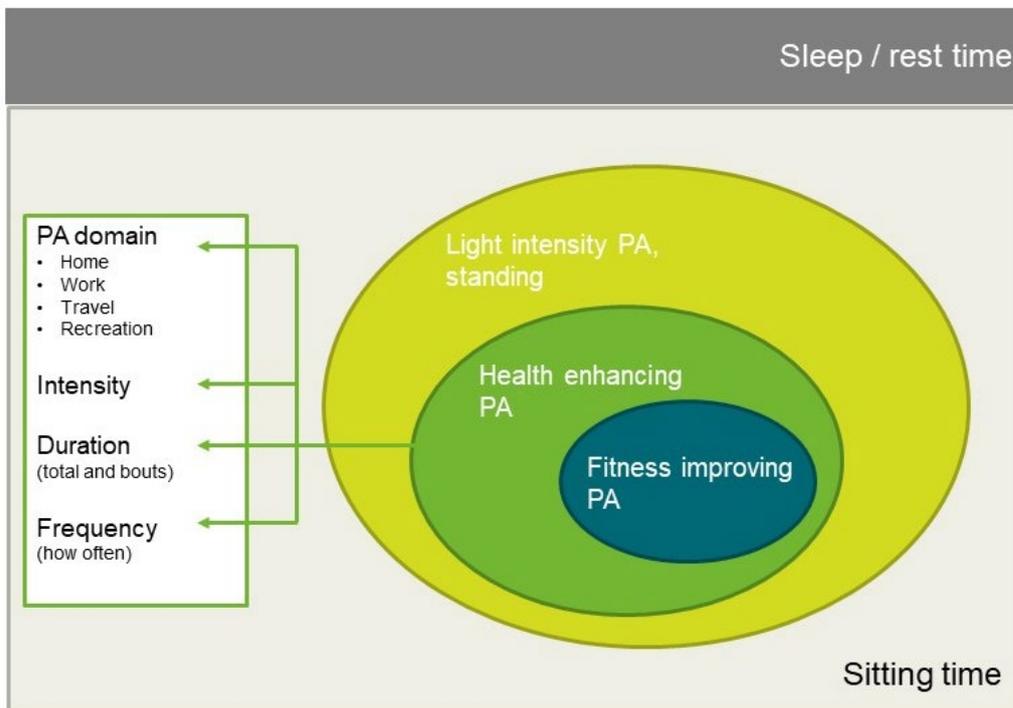


Figure 34. The spectrum of movement behaviours that might be measured

Measurement dimensions may include the frequency of PA, the intensity, the duration of activity, and the types of PA. In some generic brief PA instruments, such as the Active Australia survey³, these elements are measured broadly, as brief instruments are only six items long. In some surveillance systems, it may be relevant to measure each of the domains or settings for PA in more detail. The mode of data collection should be considered carefully, as self-report measures may provide different estimates when completed by personal or telephone interview, or online.

One problem is that when PA guidelines or recommendations change, the measures to assess them also need to be changed, and this may have a substantial impact on prevalence estimates^{4,5} (see [Chapter 1.2](#)). In reality, even small changes to the wording of self-report questions may have a large impact on PA prevalence estimates, and if instruments are changed midcourse, this may obscure accurate trends in PA.⁶ Careful attention to preserving identical PA questions over time is necessary for surveillance, even in the face of a plethora of research evidence continuously suggesting alternative and ‘improved’ measurements. Sometimes, the list of PA measures may need to be expanded, as new dimensions are recommended by updated PA guidelines. For example, in the past decade there has been increasing interest in specific measures of transport-related PA, measures of sedentary behaviour/sitting time, and measures that reflect participation in muscle-strengthening activities and exercise to improve balance. Adding new indicators to an ongoing PASS should be done without affecting the existing set of PA measures.

There has been scientific ‘pressure’ in recent years suggesting that device-based measures of PA (sometimes referred to as ‘objective measures’) are more reliable and valid than self-reported measures, and some countries have included accelerometer-based measures in their surveillance systems (notably Norway, Sweden and the US). Accelerometers measure different things to self-report PA, and although reliable, may show differential validity across accelerometer models and do not necessarily provide comparable estimates.⁷ Future attempts to harmonise raw accelerometer data may solve this problem, but currently this remains a limitation of accelerometer use. Pedometers have been effectively used in surveillance systems in Canada to monitor steps in school-aged children over time (within Canadian Physical Activity Levels Among Youth – CANPLAY national PASS⁸), and adult pedometer surveillance has been used in Japan for several decades.⁹ Pedometer measurement was used in several Australian national and state level surveys to provide a device-based indicator of PA.⁵

PA estimates can also be derived from time-use surveys.¹⁰ Such surveys have been conducted in more than 85 countries worldwide¹¹, and they inquire about the time spent in a range of daily activities, usually referring to the past day. Although PA estimates from time-use surveys show good reliability and validity¹², processing time-use survey data to obtain PA estimates may be challenging.¹³

Other possible ways of assessing population PA may be through monitoring of aggregated online data from PA apps, wearable devices such as Fitbits, smart phones and smart watches.¹⁴ These are relatively unobtrusive methods for population measurement, but their measurement properties and data sharing and privacy protocols still need to be established.

Each of these different methods of PA measurement will be relevant in different settings, have different cost structures and have different implementation challenges. An informed decision to use a particular form of measurement will be made based on a number of factors and will require consideration and advice from a PA measurement specialist.

5.3 Examples of relevant physical activity surveys in Australia

The data in Table 26 demonstrate the diversity of measures used to assess population level PA in Australia. There is a need for standardisation and consensus processes, to define which measures form the essential components of any proposed integrated and comprehensive PA surveillance system. A survey-based example that collected PA and fitness, but also environmental and organisational measures through serial population-based surveys was the NSW Schools Physical Activity and Nutrition surveys, 1997–2015 (see **Case Study** at the end of Section 5.5.3).

Table 26. Examples of population surveys of relevance to physical activity surveillance in Australia

Level of measurement, sector	Surveys	Requirements for a surveillance system
National health surveys, run by ABS, every 3–5 years	National health surveys; ABS NNPAS (2012) ¹⁵	Routine, comparable PA questions over 30 years NNPAS included pedometer measures
State health surveys Variable periodicity, some run continuously all year; surveys of adults and children	State-based health survey systems. These typically ask about PA participation, but sometimes include questions on strength training, sedentary time, screen time among children	Note that these surveys use slightly different questions across jurisdictions, so they are not always comparable, and questions sometimes change over time ⁵
Routine adolescent health surveys, led by Cancer Council of Victoria	Regular NaSSDA surveys ¹⁶ , provide sufficient samples for some state-level prevalence estimates	Use validated single item PA question for adolescents
Various large health related cohort studies	Large sample cohort data, with repeated measurements on the same individuals; for example, HILDA and LSAC (children), 45&Up, AusDiab, ALSW, Raine (adults and older adults)	Follow same individuals with drop out occurring; but provide useful data on PA correlates and possibly impact evaluation data for assessing population intervention effects
Sport sector	Sport participation surveys (PSM 1990s, then ERASS in the 2000s, then a five-year hiatus, and then AusPlay surveys 2015 onwards ¹⁷)	Population surveys of sport participation and its distribution; changes to surveys and sampling preclude long-term trend analysis

Level of measurement, sector	Surveys	Requirements for a surveillance system
Economic and labour force statistics	Time-use surveys ¹² – less frequent surveys, reflect total time used across the day	Can be used to estimate long-term trends in PA and time spent in sedentary behaviours
Department of Transport (various jurisdictions)	Transport and travel surveys: describe trips and trip modes using a two-day diary in representative population samples (see Case study at the end of this chapter for indicators developed from state-based transport surveys)	Allows estimates and establishing long-term trends in active travel (AT); data access for PA surveillance purposes varies across jurisdictions, for data trend example, see Merom et al 2010 ¹⁸
Other/miscellaneous population surveys	Other surveys, such as the ABS General Social Survey, sometimes asked PA relevant questions; ABS Census is useful for trends in mode of travel to work on the Census day	Several non-health data sources could be considered for inclusion in any PA surveillance system

ABS NNPAS = Australian Bureau of Statistics National Nutrition and Physical Activity Survey; NaSSDA = National Secondary Students' Diet and Activity; HILDA = Household, Income and Labour Dynamics in Australia survey; LSAC = Longitudinal Study of Australian Children; 45&Up = surveys from the Sax Institute's 45 and Up Study; AusDiab = Australian Diabetes, Obesity and Lifestyle Study; ALSW = Australian Longitudinal Study on Women's Health; Raine = surveys from the Raine study; PSM = Population Survey Monitor; ERASS = Exercise, Recreation and Sport Survey

5.4 What kinds of physical activity questions exist in international surveillance systems?

Internationally, through the WHO STEPwise approach to surveillance (STEPS), the GPAQ (Global Physical Activity Questionnaire) is widely used in more than 100 countries for assessing domain-specific population PA levels. Surveillance systems for adolescent PA have occurred internationally through the WHO Global School Health Survey, and through the European Health Behaviour in School-aged Children Survey (assessing health behaviour in school children in 49 countries). Within countries, long term monitoring of PA has occurred in the US through, for example, the Behavioral Risk Factor Surveillance System (BRFSS), in Canada through the Physical Activity and Sport Monitor (PAM) surveys, and in Finland and Baltic countries through the Finbalt Health Monitor surveys, providing long-term comparable questions to assess PA trends.

Note that some surveillance systems ask detailed questions about each of the activities that the respondent reported in the previous *12 months* (e.g. in the Canadian PAM), which provides a period prevalence estimate for PA as well as for sport participation. Most surveys ask shorter PA questions, usually recalling PA over the previous one to four weeks. These are typically 6 to 20 questions long and may provide data on domains of PA (work/domestic, transport activity, leisure time activity) or just generic total PA estimates, often characterised as the total time or relative energy expenditure in walking, moderate intensity activity and vigorous intensity activity.

5.5 Beyond individual behavioural measures: building a PASS

5.5.1 Overview of a PASS

Comprehensive surveillance requires assessment of the PA system, not just estimates of PA behaviours (See Table 27). A PASS is a modular structure, with components added as necessary in a particular setting or jurisdiction, or for particular purposes. For example, the Canadian PAM¹⁹ surveys standardised data for both health and sport sectors, and for all 13 provinces and territories. This system collects data from organisations, municipalities and several sectors regarding policy and programs across Canada, as well as monitoring individual PA and sport behaviour.

As shown in the table below, there are routine survey indicators that need to form the long-term components of PA surveillance (level 3 measures). Then, a PASS might collect routine organisation level and policy implementation indicators (shown as level 2 indicators in the table). Examples of ecological-level indicators are shown in the **Case studies** at the end of Section 5.5.3, particularly the community-wide system-level indicators developed to monitor the **Victorian Health and Wellbeing** initiative. More acute or short-term implementation measures may be added as needed to a PASS to reflect more immediate indicators of a particular component of the overall PA strategy.

Planning and designing a PASS should be a part of developing any national or regional PA strategy, and the PASS should be integrated into the PA plan. It is more difficult in situations where there is no specific PA plan, where elements of PA surveillance are embedded in general population health indicators, or in an obesity or chronic disease strategy. It is difficult to measure the unique PA-related inter-agency components of a PASS in such 'embedded' situations, as the 'system' is broader and more diffuse if all chronic disease or all population health indicators are included.

Table 27. Levels of indicators in a PASS

Measurement purpose and frequency of assessment	Measurement purpose	Examples
<p>Level 1. Short term implementation</p> <p>Ad hoc process measures as needed</p> <p>No routine measurement</p>	Implementation Indicators [process]	<ul style="list-style-type: none"> PA implementation policy and plan Mobilisation of resources and timeframe Delivery of programs as intended to reach targets (e.g. school physical education (PE) delivered; municipality builds of multi-use parks) Creation of infrastructure on time and budget
<p>Level 2. Organisational and policy indicators</p> <p>Routine surveys or audits of key organisations, stakeholders and environments</p>	Settings; system	<ul style="list-style-type: none"> Routine surveys of workplaces, schools, primary care, local government, transport and planning sectors Workplace policy implemented Audits to monitor the built environment Systems to monitor non-health indicators such as public transport or park usage Surveys or interviews of stakeholders
<p>Level 3. Core survey-based indicators</p> <p>Routine individual-based surveys on PA behaviours and correlates</p>	Individual	<ul style="list-style-type: none"> Surveys among population-representative samples Measures of PA antecedents such as access to services, social norms and support, intention, self-confidence to be active, barriers Measures of other health indicators such as wellbeing, mental health, other health outcomes

5.5.2 Principles of a comprehensive PASS

A comprehensive PASS should be designed according to the principles set out in Table 28.

Table 28. Design principles for a PASS

Design principle	Description
1. Generalisability	It will provide population-generalisable estimates
2. Simplicity	It will cause minimal respondent and researcher burden
3. Data quality	It will provide reliable and responsive estimates of population-level PA
4. Comprehensiveness	It will collect data on all essential components of individual-level PA behaviour and the PA system
5. Between-jurisdictional comparability	It will use standardised measures, to allow for comparisons among jurisdictions and with other countries
6. Continuity and sustainability	It will retain comparable measurement methods over time, to identify trends
7. Adaptability	Its data collection protocols will be flexible enough to enable any essential adaptations to be made without affecting comparability of data over time
8. Affordability	It will require dedicated, secure funding, distributed across different components/measures

5.5.3 Measures for a PASS

Deciding on the choice of measures depends on whether the PASS is standalone and linked to a PA plan, or whether it is being used to assess which components of a PASS can be included in existing chronic disease- or obesity-monitoring frameworks, in which PA is often subsumed. There is no clear guidance on which elements are mandatory, as it depends on the jurisdictional definitions of 'meeting PA guidelines', the organisational change strategies that require monitoring, and the urban environmental/transport interventions that are included as part of prevention strategies. From existing strategic planning documents, a set of PASS-related components can be developed. Note that PASS measures should only be applied where actual change is feasible within the timeframe of the strategic policy; incomplete policy definitions or uncertain timeframes should preclude the use of PASS measures, as otherwise uncertain or incomplete conclusions may be drawn.

The types of measures that could be embedded in a PASS include those set out in Table 29.²⁰

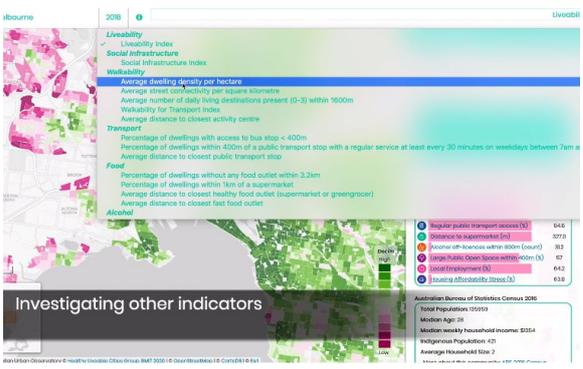
Table 29. Types of potential measures for a PASS

Type of measure	Description and examples
1. Individual-level measures	<p>These would be obtained from surveys for all age groups and possibly in any special population group or target group identified in the strategy. They may include:</p> <ul style="list-style-type: none"> Measures of PA participation; derived from health-enhancing PA measures; or from transport surveys, occupational surveys, sport participation surveys, or time-use surveys [level 3 measures] Measures of muscle-strengthening activity and sedentary behaviour/sitting time [level 3 measures]

Type of measure	Description and examples
	<ul style="list-style-type: none"> Community views and support for PA behaviour changes, support for public transportation, support for changes in the built environment, support for PA programs at the local level [level 1 measure, as needed] Individual-level antecedents and determinants of PA, which might include intention to be physically active, attitudes towards PA, perceived barriers to being active, and community awareness of the recommended amounts of PA [level 3 measures]
2. Organisational-level measures	<p>The following are possible examples [all level 2 measures]:</p> <ul style="list-style-type: none"> Engagement of municipalities or local councils Engagement by childcare and preschool facilities Engagement and changes in schools, PE, wider school/educational environments, AT to school, use of the school before and after class time for PA Participation by workplaces in providing PA advice, programs, and opportunities Engagement of the healthcare setting, activity recommendations in primary care, and PA recommendations for people with existing chronic diseases Engagement of workplaces in implementing PA strategies and policies, activity facilities at work, and travel to work incentives
3. Macro-level (policy/system) indicators	<p>For example, including:</p> <ul style="list-style-type: none"> The existence of a PA national plan The existence and maintenance of cross-sectoral partnerships to promote PA, coalitions and support structures Committed PA resources in strategic documents Commitments by non-government organisations and other agencies to PA [this is qualitative, but is part of level 2 measurement]
4. Built environment and transport measures	<p>Measures of the built environment and transport environment, walkability, related urban form and urban density measures [level 2 measurement; see Case study of the Australian Urban Observatory, at the end of this section]</p>
5. Monitoring of policies, practices, program implementation and reach	<p>Monitoring of policies and practices around PA, monitoring of implementation of programs and their population reach [ongoing measure, level 2]</p>
6. Monitoring of dissemination, reach and uptake of PA guidelines	<p>Monitoring of the dissemination and reach of PA guidelines and their uptake by professional organisations and groups, in the general population, and within communities (this is part of assessing the reach of the PA strategy, level 2 measure)</p>
7. Additional indicators specific to certain types of PA and settings for PA	<p>Additional indicators relevant to specific types and settings for PA that can be linked to any level of measurement. For example, a sport participation surveillance system may need details of specific sports and the extent, type, and costs of participation. A different setting, such as transport, may need data on the nature and mode of reported trips, on car usage, and possibly air quality indicators, as well as behavioural measures of active or passive transportation</p>

Some **Case Studies** are provided below as examples of cross-sectoral surveillance efforts that monitor a component of the PA system. These reflect indicators for urban form, measurement indicators from transport surveys for AT, a NSW survey system for school children and adolescents, and a set of indicators for a state-based system to monitor health and wellbeing outcomes in Victoria.

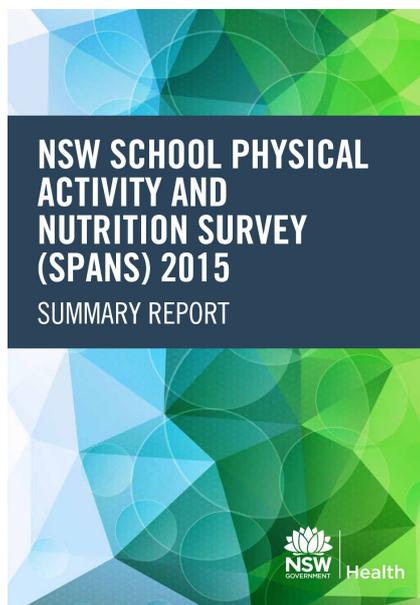
Case study: Australian Urban Observatory

https://auo.org.au/	
<p>The Australian Urban Observatory is an online tool developed by RMIT health and urban researchers that policy makers can use to measure and compare the liveability of Australian cities, suburbs and neighbourhoods across the domains depicted to the right. The tool can therefore support decisions about resource allocation and policies and programs to create equitable, healthy and liveable places.</p>	
<p>Users can access indicators for each of the domains, visualise the indicators within a specific area, and compare indicators across major capital cities for different areas.</p>	
<p>Indicators have been chosen based on their association with health and wellbeing outcomes and connection to government policies. The Observatory website explains the rationale for each indicator, what the indicator measures, and how it is measured (see example to the right which describes the methodology behind measurement of the indicator 'Public open space').</p>	<p>Methodology</p> <p>Three datasets were used in the GIS analysis: public open space, <u>the pedestrian road network</u>, and <u>sample points</u>. Pedestrian road network distances were calculated from each sample point to all areas of open space within 3200 metres. Pseudo-entry points were created along the perimeter of each area of open space at 50 metre intervals, where this perimeter was within 30 metres distance of an accessible path. Areas of open space, and those which may be considered publicly accessible, were identified using a detailed set of OpenStreetMap tags and morphological criterion. Publication of the full method is forthcoming.</p>
<p>There is a short video tutorial on the website which explains how to use and interact with the Observatory maps:</p> <p style="text-align: center;">auo.org.au/wp-content/uploads/2020/02/observatoryTutorial.mp4</p>	

Case study: NSW Schools Physical Activity and Nutrition Surveys (SPANS) (1997–2015)

Weblink to the 2015 SPANS survey: www.health.nsw.gov.au/health/Pages/spans-2015-full-report.aspx

The **NSW SPANS** (*Schools Physical Activity and Nutrition Survey(s)*) were carried out every ~5 years between 1997 and 2015 on representative samples of NSW School students. These were sampled from primary school grades 2, 4, and 6, and secondary schools grades 8 and 10, and collected data on PA and sport participation, the school environment, PE policies, and in addition, objectively measured fitness using the 20 m beep test, and measured fundamental movement skills, related to the capacity for sport and PA participation.



Examples of data summaries for primary school (upper row) and secondary school pupils (lower panel)



- ▶ **Less than 1 in 4 (23%) children met the physical activity recommendation every day.**
- ▶ **Among children from Asian cultural backgrounds this was around 1 in 10 (11%).**



- ▶ **63% of children were in the healthy fitness zone for cardiorespiratory fitness.**
- ▶ **37% of children were in the healthy fitness zone for muscular fitness.**



More than half of adolescents (59%) were in the healthy fitness zone for cardiorespiratory fitness.

Case study: Indicators of active transport (Victoria)

www2.health.vic.gov.au/about/publications/policiesandguidelines/victorian-public-health-and-wellbeing-outcomes-framework

The Victorian Public Health and Wellbeing Outcomes Framework embeds PA measures as part of a broader outcomes framework. The framework brings together indicators from multiple data sources, including for AT.

Example of the information provided by the Data Dictionary for the active transport measure

Domain 1: Victorians are healthy and well
Outcome 1.3: Victorians act to protect and promote health
Indicator 1.3.1: Increase healthy eating and active living

Measure	Proportion of journeys that use active transport	
Rationale	Active transport refers to unassisted travel (walking) or non-motorised (bicycle) transportation with an intended purpose or destination. Active transport has many demonstrated benefits – personal (health and fitness), social (community connectivity), environmental (reduced carbon footprint) and economic (infrastructure costs). Adults who walk for transport are more likely to achieve sufficient physical activity than those who do not. A significant proportion of public transport users report that they meet all their recommended levels of physical activity just from their active transport associated with public transport use.	
Measure detail	1.3.1.7	Proportion of journeys that use active transport
Target	Not set	
Definition	<i>Numerator:</i>	Number of trips recorded by household residents on their survey day made in part or fully by walking and/or bicycling
	<i>Denominator:</i>	Total number of trips in survey, weighted to mid-year population estimate (Source–ABS)
	<i>Mode:</i>	Proportion
Data source	<i>Baseline and future:</i>	Victorian Integrated Survey of Travel and Activity (VISTA) DEDJTR
	<i>Alternatives:</i>	VPHS (reported as indicators of adults cycling for transport and adults walking for transport)
Data availability	<i>Baseline year:</i>	2012–14
	<i>Frequency:</i>	Annual for Melbourne (based on rolling 2-year average); every 4–5 years for Geelong and regional centres
Breakdown	Data available for the survey area by age, sex, purpose of journey, day (all days, weekday, weekend), transport mode and household income, and by location (Melbourne inner/middle/outer, Geelong and Regional centres).	
Comparability	National, state and territory comparison unavailable.	
Linked to	Proportion of adults, adolescents and children who are sufficiently physically active (Measure detail 1.3.1.6.A–C) Proportion of adults, adolescents and children who are overweight and obese (Measure detail 1.3.2.1.A–F) Liveability (TBD) (Measure detail 5.1.1.1)	
Further information	Nil.	

Where data is available, the Outcomes framework also enables assessment of health and wellbeing inequalities.

Snapshot of available population groups and geographic breakdowns for PA measures in the framework

Measures (detailed)	Equalities and inequalities (state level)											Geographical		
	State	Age	Sex	Aboriginal and Torres Strait Islander	Cultural and linguistic diversity	Sexual orientation and gender identity (LGBTI)	Socioeconomic status	Disability / special healthcare needs	Mental health / psychological distress	Chronic / long-term condition	Metropolitan/rural	Regional	Local government area	
1.3.1.5	Proportion of infants exclusively breastfed to three months of age	Y	Y	N/A	Y	P	N	P	N	N	N	P	Y	P
1.3.1.6.A	Proportion of adults who are sufficiently physically active	Y	Y	Y	P	Y	N	Y	N	Y	Y	Y	Y	Y
1.3.1.6.B	Proportion of adolescents 10–17 years who are sufficiently physically active	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	P
1.3.1.6.C	Proportion of children 5–12 years who are sufficiently physically active	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	P
1.3.1.7	Proportion of journeys that use active transport	Y	Y	Y	N	N	N	Y	N	N	N	N/A	Y	N/A
1.3.1.8	Proportion of people participating in organised sport (TBD)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

5.6 Conclusion: Guidance for policy makers

Developing a PASS is a major undertaking, but it is an essential part of PA strategic planning. It comprises a planned collection of information to understand and support the implementation and evaluation of a PA strategy.²¹ It is part of the planning phase of a PA strategy and provides information that should be used continuously to aid refinement and modification of the strategy implementation. Expert decisions need to be made about the measures used, and there needs to be long term commitment to maintain identical measures throughout the lifecycle of a PASS (especially level 2 and 3 measures). If PA is embedded in other prevention-related activities, then elements of the PASS relevant to that system assessment should be used. In optimal circumstances, a comprehensive PASS is a multilevel integrated set of indicators and measures that monitors implementation of a national PA plan, and assesses individual-level behaviours, organisations, settings and sectors, and their relationships in the PA system over time.

Further resources and examples

Refer to the links listed under ‘[Surveillance and monitoring](#)’ in [Appendix 5](#) for other useful resources and guidance.

Refer to [Appendix 3](#) for some illustrative examples of policies, programs and other initiatives in Australia that relate to this domain (particularly those described under [GAPPA 4.2, 4.3](#)).

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