

Abstract

Background

Temporal changes in sedentary behaviour patterns reflect the evolving nature of our built and social environments, particularly the expanding availability of electronic media. It is important to understand what types of sedentary behaviour are assessed in national surveillance to determine whether, and to what extent, they reflect contemporary patterns. The aims of this review were to describe the characteristics of questionnaires used for national surveillance of sedentary behaviour and to identify the types of sedentary behaviours being measured.

Method

We reviewed questionnaires from national surveillance systems listed on the Global Observatory for Physical Activity (GoPA!) country cards to locate items on sedentary behaviour. Questionnaire characteristics were categorised using the Taxonomy of Self-reported Sedentary Behaviour Tools (TASST). The purpose and type of sedentary behaviours captured were classified using the Sedentary Behaviour International Taxonomy (SIT).

Results

Overall, 346 surveillance systems were screened for eligibility, of which 93 were included in this review. Most questionnaires used a single item direct measure of sitting time (n=78, 84%). Work and domestic were the most frequently captured purposes of sedentary behaviour whilst television viewing and computer use were the most frequently captured types of behaviours.

Conclusion

National surveillance systems should be periodically reviewed in response to evidence on contemporary behaviour patterns in the population and the release of updated public health guidelines.

Background

During the last two decades, there has been a considerable increase in research assessing sedentary behaviour and its potential links with health.¹ Sedentary behaviour defined as “*any waking behaviour characterised by an energy expenditure ≤ 1.5 METs while in a sitting or reclining posture*”,^{2(p.1)} has been identified as a risk factor for all-cause mortality as well as various chronic diseases including cardiovascular disease, cancer, and type 2 diabetes.^{3,4} In addition, time spent in a variety of sedentary behaviours, particularly screen-based activities, appears to be increasing.⁵⁻⁸ As a result, various authorities have released public health guidelines on sedentary behaviour. For example, the World Health Organization (WHO) recommend that adults should limit the amount of time they spend being sedentary,⁹ whilst national guidelines in Canada advise limiting daily sedentary time to 8 hours or less and not exceeding 3 hours of recreational screen time.¹⁰ To assess compliance with public health guidelines, assessment of sedentary behaviour should be incorporated into population surveillance systems.

A surveillance system can be defined as “*a systematic collection, analysis and interpretation of the health-related data needed for the planning, implementation, and evaluation of public health practice*”.^{11(p.3)} Population surveillance supports evidence informed decision making in public health by monitoring how many people are meeting public health guidelines, identifying risk factors associated with health and disease, and informing public health policies and programmes.¹²⁻¹⁴ Many tools exist

for the assessment of sedentary behaviour, but not all are suitable for use within population surveillance.¹⁵ Whilst device-based measurement is becoming increasingly widespread in epidemiological research more broadly, it is often considered too time or resource intensive to be used for population surveillance and fails to capture the different domains and types of sedentary behaviour that people undertake.¹⁶ Comparatively, self-report tools have been found to have low to moderate validity, typically underestimating total sedentary time compared to device-based measurement.^{17,18} Nevertheless, their relatively low cost and burden mean that use of self-report measures is likely to continue in surveillance systems for the foreseeable future.¹⁴

Emerging evidence suggests that the nature of our sedentary behaviour patterns is changing. One recent analysis, covering the period 2012 to 2019, reported an increase in time spent using a mobile phone, games consoles and watching online television, along with a decline in traditional (terrestrial) television viewing and PC, laptop and tablet use.⁶ Other studies have reported a similar trend in the changing make-up of sedentary behaviours over time.^{7,19} Against this backdrop, it is vital that surveys used for population surveillance adequately capture contemporary behaviour patterns.¹⁶ This is necessary to ensure that prevalence estimates are accurate, but also because different modes of sedentary behaviour may have different associations with health.¹⁶ For example, television viewing has been linked with depressive symptoms and reduced cognitive function, whereas internet use and reading have been associated with reduced depressive symptoms and higher cognitive function.²⁰ Therefore, the overall purpose of this review was to identify what types of sedentary behaviour are being captured in surveillance systems and how these behaviours are being measured. The specific aims were to: 1) describe the

characteristics of questionnaires used for national surveillance of sedentary behaviour in adults; and 2) identify the types of sedentary behaviours being measured in these questionnaires.

Methods

The methods and findings from surveillance systems are not typically published in the peer-reviewed literature. As such, rather than conducting a conventional search of scientific databases, we used the Global Observatory for Physical Activity (GoPA!) country cards²¹ to locate potentially relevant sources of information for this review. The GoPA! country cards, currently available for 217 countries, are a summary of country level data on a variety of physical activity and sedentary behaviour metrics, including population surveillance.^{22,23} The cards are populated using a standardised methodology and all content is approved by a designated 'country contact' prior to publication.²⁴ Whilst most surveillance systems included on the country cards meet the definition provided above, some are more aptly described as epidemiological (cross-sectional/cohort) studies. Nonetheless, such studies may offer similar insights as conventional surveillance, and given that their inclusion is subject to approval by a designated country contact, we opted to retain such studies within our review.

Inclusion and exclusion criteria

Surveillance systems were included if they i) measured duration of sedentary behaviour in the adult population and ii) used a nationally representative sample which was determined by examining the sample section of relevant reports or websites. Surveillance systems that used a non-national (i.e., local, or regional) sample were only included when a surveillance system using a nationally

representative sample could not be obtained; in such cases, the most recent surveillance system using a non-national sample was included.

No limits were set on how many surveillance systems could be included for a given country. If multiple surveillance systems were reported for a country, we selected the most recent available wave for each one that met the criteria. Surveillance systems were excluded if the questionnaires could not be obtained in their entirety.

Additionally, questionnaires were excluded if they were designed specifically for use within children or if they only included questions on device ownership, screen/technology access or frequency of use. For this review, the 2017 Eurobarometer Survey was only included once as the questions remained unchanged across each country in which it was used. Similarly, the WHO STEPwise approach to surveillance was included once where no adaptations to the survey were made. However, STEPS allows flexibility for countries to make adaptations; therefore where surveys differed to the original STEPS, these were considered separately.²⁵

Locating sources

Data were extracted from the second set of GoPA! country cards, published in 2020.²² All sources of data listed under the following sections of the country card were considered for inclusion: 'Physical Activity Prevalence', 'Surveys and instruments used to assess physical activity', and 'Sedentary Behaviour (sitting time)'. Surveillance systems were assessed by one member of the research team (DH) to identify when the data collection took place. Once the relevant surveillance system(s) had been identified for each country, we sought to obtain the questionnaires to determine whether a question was included on the duration of

sedentary behaviour. Questionnaires written in languages other than English were translated using the Google Translate app. We followed a pre-defined process to locate the questionnaires, as follows:

First, we conducted an internet search using the Google search engine. The reference for many of the sources listed under the 'physical activity prevalence' heading on the country cards was Guthold et al.(2018)²⁶ which described global and regional trends in insufficient physical activity using a pooled analysis from 358 population-based surveys. In these cases, we used the supplementary file of Guthold et al.(2018)²⁶ to identify the original data sources and used Google searches to obtain the questionnaire(s). If a questionnaire was not obtained through Google searches, a bespoke email was sent to the country contact(s) requesting a copy of the missing questionnaire(s). If a response was not received within 10 days, a follow-up email was sent. If a response was not received within 10 days of this follow-up, no further attempts were made to obtain this information. Figure 1. is an adapted PRISMA flow diagram²⁷ which depicts the process we followed for surveillance system selection.

Data extraction

Information pertaining to each of the included surveillance systems, such as year of measurement and sampling characteristics, were recorded in a Microsoft Excel spreadsheet. We also extracted verbatim text for the sedentary behaviour questions, including any pre-amble and response options.

Data synthesis

Data synthesis comprised two parts. To describe the characteristics of the included questionnaires, we used the Taxonomy of Self-reported Sedentary Behaviour Tools (TASST). To record the behaviours captured within each questionnaire, we used the Sedentary Behaviour International Taxonomy (SIT). TASST and SIT are described in more detail below. To ensure accuracy when mapping the questionnaires, two members of the research team (DH and AA) separately mapped approximately 10% of the surveys for both frameworks. The results were compared and any discrepancies were discussed and cross checked with the coding for the original frameworks and Rivere et al. (2018)²⁸ for the SIT. Through this process we established clear practices for the remaining surveys which were mapped by DH.

Questionnaire characteristics

Questionnaire characteristics were mapped using a modified version of the TASST, as depicted in Figure 2.²⁹ The TASST describes the characteristics of self-report sedentary behaviour measurement tools, captured in four domains: type of assessment, recall period, temporal unit, and assessment period. *Type of assessment* refers to how the outcome of time spent in sedentary behaviour is produced from the instrument and can be either a single or composite item. Composite measures comprise 2 or more items assessing behaviours or domains. We added a new sub-category of 'behaviours and domains' (1.2.2.3, Figure 2) to capture questionnaires that measured both behaviours and domains, which was not included in the original taxonomy. *Recall period* is the time frame over which respondents were asked to consider their sedentary behaviour, for example, a previous day or previous week. *Temporal unit* is the time within the recall period that an individual reports their sedentary behaviour; this can be a single day, a week or longer. Finally, the *period of assessment* refers to whether there are any parameters

set on the temporal unit, for example, periods within the day (e.g., before/after work) or distinguishing week/weekend days.

If there were multiple questions measuring sedentary behaviour in a questionnaire that had a degree of similarity in question style, theme, and/or response options, then these were included collectively and reviewed as one. For example, a questionnaire that included separate questions on duration of television viewing and computer use on a weekday was mapped once onto the taxonomy. Where questions were stylistically and/or thematically different they were included as distinct items and mapped separately.

Sedentary behaviour characteristics

Characteristics of the behaviours that were assessed in each questionnaire were mapped using the SIT.³⁰ The SIT consists of 9 facets (purpose, environment, type, posture, social, time, state, associated behaviours, and measure) two of which were relevant to the current review. The *purpose* facet (Figure 3) was used to describe the contexts in which the sedentary behaviours took place, whilst the *type* facet (Figure 4) was used to describe the types of sedentary behaviours that were assessed. The “other” category shown in Figures 3 and 4 was used in cases where the purpose or type of behaviour did not fit into one of the pre-determined categories. Each facet on the SIT also includes an ‘undetermined’ category. Although not shown on Figures 3 and 4, this category was used if the purpose or type of sedentary behaviour could not be determined from the questionnaire.

We mapped the questionnaires according to the purpose(s) and type(s) of sedentary behaviour that they assessed. The *purpose* facet was used in its original format. We made a small number of amendments to the *type* facet, as shown in Figure 4. The

non-screen category of 'phoning' was changed to 'phone calls' to provide clarity on phone use, given phones can now be used for a variety of activities including watching videos and browsing the internet.³¹ Additionally, 'driving' was revised to include driving and using public transport to capture questions that included a measure of sitting on public transport. For screen behaviours, we replaced the 'small devices' category with two new categories of i) iPad/Tablet/E-reader, and ii) smartphone, as recent research has shown differences in patterns of phone and tablet use, with smartphone use increasing and tablet use decreasing.⁶

Consistent with Riviere et al. (2018)²⁸ we also recorded the examples that were given for a sedentary behaviour facet or categories included in a facet (e.g., work or television) in each questionnaire. These were mapped separately from the main question. When mapping the questionnaires onto the taxonomy, "free time" was included under the purpose of 'leisure'. Many questionnaires included the example of "sitting at a desk"; in these instances, sitting at a desk was classified under the work purpose when work was mentioned within the question and under the education purpose if school or studying was mentioned within the question. If neither work nor education were mentioned, the example of sitting at a desk was placed under the "undetermined" category.

Results

Overview

From 346 surveillance systems screened for eligibility, we located 93 questionnaires from 135 countries. Characteristics of the questionnaires in relation to global region and The World Bank income classification are presented in Table 1. Over a third of the questionnaire units (n=33, 35%) used the WHO STEPwise approach to

surveillance.²⁵ Just under a third of countries (n=30, 32%) used the 2017 Eurobarometer survey,³² with at least one national survey being included in addition to Eurobarometer in half of these countries (n=15).

Questionnaire characteristics

Of the 93 questionnaires that were included in the review, nine contained multiple items on sedentary behaviour that could not be categorised in their entirety in the TASST due to variability in the question characteristics. These nine questionnaires were subsequently split into 20 question items and mapped separately. Hereafter, we use the term 'questionnaire units' to refer collectively to complete questionnaires *and* these 20 questionnaire items. A total of 104 questionnaire units were mapped onto the TASST, comprising 84 complete questionnaires and 20 question items.

Characteristics of the 104 questionnaire units that were mapped onto the TASST are summarised in Table 2. Most questionnaire units (n=83, 80%) were single item direct measures of sitting time. Proxy single-item measures of sedentary behaviour were based on television viewing (n=2, 1%), travel (n=2, 1%) and computer use (n=1, 1%). A composite assessment was used in 21 questionnaire units, of which 17 used a composite measure of a sum of behaviours and 4 used a sum of behaviours and domains (e.g., at home watching television).

Most questionnaire units used an unanchored recall period (n=65, 63%), meaning respondents were asked about a general period of time, such as a typical day rather than specifying a particular period of time. Almost all questionnaire units used a temporal unit of a single day (n=100, 96%) with the remaining requesting a weekly estimate (n=4, 4%). For the assessment period, almost three quarters of questionnaire units (n=76, 73%) were classified as "not defined" meaning they did

not specify any parameters on the temporal unit. Fourteen questionnaire units (13%) specified weekdays only, 12 (12%) specified both weekdays and weekend days, and two (2%) stated a subdivision of the day with both questionnaire units stating before 6pm and after 6pm on a weekday and weekend.

Sedentary behaviour characteristics

The behavioural characteristics of the 93 included questionnaires were mapped onto the SIT as shown in Table 3. We firstly mapped the questionnaires according to the purpose(s) and type(s) of sedentary behaviour that they assessed. We then mapped the examples of sedentary behaviour that were used within the questions.

Purpose

Most questionnaires measured more than one purpose, with the categories of work (n=60, 65%) and domestic (n=48, 52%) being captured most frequently. Fewer questionnaires assessed the purposes of leisure (n=21, 23%) and education (n=10, 11%), with 11 having an undetermined purpose. The purpose categories of work (n=63, 68%), travel (n=49, 53%), and social (n=47, 51%) were included most frequently within the examples.

Type

Most questionnaires captured total sitting time (n=77, 83%) while 26 (28%) questionnaires captured any form of screen/non-screen-based sedentary behaviours. For non-screen behaviours, questionnaires referred to reading (n=3, 3%) and driving/using public transport (n=3, 3%) most frequently. For the screen-based behaviours, TV (n=21, 23%) and computer use (n=15, 16%) were the behaviours

captured most frequently. Fewer questionnaires captured iPad/tablet/E-Reader (n=7, 8%), smartphone (n=5, 5%) and videogame use (n=4, 4%).

With regards to the example behaviours provided with the questionnaires, the non-screen examples were mostly classified as reading (n=63, 68%), driving/using public transport (n=49, 53%) and “other”. The most common behaviour categorised as ‘other’ was playing cards. The screen behaviour most frequently given as an example was TV viewing, which was included in 67 questionnaires. The screen behaviours of PC use (n=21, 23%), playing video games (n=12, 13%), using an iPad/Tablet/E-Reader (n=7, 8%) or smartphone (n=5, 5%) were included less frequently.

Discussion

Using 93 questionnaires from 135 countries, we describe the characteristics of sedentary behaviour assessment in national surveillance systems. Based on classification using TASST, we found that most systems used a single item direct measure of total sitting time, with some using a single item proxy measure or a composite measure, but this was less common. In addition, through the use of the SIT, we found that most questionnaires referred to multiple purposes, with work and domestic being the most frequently captured. TV viewing and computer use were the most frequently captured types of sedentary behaviours.

A single item direct measure of total sitting time was the most frequently used question type identified in our review. Single-item questions are generally preferred in surveillance systems because they take up relatively little space within the survey, and have low participant burden.^{33–36} However, single item measures of sitting time do not provide information on the type and domain of behaviours; this is important

because there is evidence that specific types of sedentary behaviour are uniquely associated with morbidity and mortality, sometimes more strongly than overall sitting time.^{28,34,37,38} In addition, many single item measures provide less accurate estimates of sedentary time than composite questionnaires comprising multiple items.^{34,39} Whilst most of the questions included in our review asked the respondent to report their duration of sitting/lying down, there were some subtle differences in language. For example, some questions referred to sitting only whilst others referred to resting or reclining (further details are provided in Supplementary File 1). The impact of these differences in phrasing on reported duration and subsequent prevalence estimates is unclear, but they may impact the validity of between country comparisons.

A key function of population surveillance of sedentary behaviour is to monitor compliance with national guidelines.¹⁴ The predominant assessment of total sitting time is consistent with most public health guidelines, which typically recommend that sedentary behaviour (in general) be limited (without specifying an upper limit), though a small number of countries, such as Canada,¹⁰ have produced quantified and behaviour specific recommendations. In such cases, surveillance instruments may need to be amended to ascertain population compliance with these guidelines. In the context of physical activity surveillance, a recent review in older adults found that from 38 surveys, only five included a question asking about muscle strengthening activities and none asked about balance and coordination activities, both of which are key components of public health guidelines.⁴⁰ It is imperative that population surveillance systems include appropriate questions that measure all aspects of both physical activity and sedentary behaviour guidelines to generate accurate prevalence estimates.

Historically, sedentary behaviour research has had a strong focus on time spent TV viewing and its association with health and well-being.⁴¹ We found that relatively few surveillance systems (only 19%) captured time in specific behaviours, but those that did predominantly assessed time spent watching TV or using a computer. This is consistent with findings by Riviere et al. (2018)²⁸ in their review of sedentary behaviour questionnaires. Periodically, surveillance tools may need to be updated to ensure they adequately capture contemporary behaviour patterns. For example, secular data indicate that time spent watching traditional (terrestrial) television has declined in recent years, whilst time spent using a mobile phone and watching online television has increased.⁶ A key challenge to this process will be ensuring 'backwards compatibility' in questionnaire content to ensure that updated questionnaires are sufficiently consistent with older versions, such that data on temporal trends is accurate, whilst also capturing newer types of behaviour. This will likely require piloting and validity testing of new questionnaires prior to them being rolled out.

In addition to mapping the behaviours explicitly measured in the questionnaires, we also captured any accompanying examples used in the question pre-ambles or main text. The types of sedentary behaviours most commonly provided as examples in the questionnaires were reading, driving/using public transport, playing cards, and watching television. Example behaviours provided in questionnaires are important because they serve as prompts for respondents and may influence the estimates that an individual provides. In the context of physical activity measurement, Cusatis and Garbarski (2018)⁴² reported that priming participants to think about specific activity domains, either separately or collectively, significantly impacted upon subsequent estimates of weekly physical activity duration. Furthermore, research

assessing understanding of physical activity questionnaires indicates that many respondents believe the list of activities provided as examples are too long and they were unsure whether the activities provided were an exhaustive list or merely examples.⁴³ These findings suggest that the number and type of behaviours provided as examples may impact participant responses but this is an under-researched area, particularly with regard to sedentary behaviour. We suggest the number and types of behaviours included as examples should be carefully considered when updating or developing new tools for population surveillance of sedentary behaviour to ensure they reflect current behaviour patterns.

We acknowledge the following strengths and limitations of this review. A strength is the location of data sources using the most recent GoPA! country cards, which provide an overview of physical activity and sedentary behaviour surveillance systems used globally. In addition, we used rigorously developed classification tools (TASST and SIT) to describe and categorise questionnaire characteristics, facilitating synthesis and comparisons between surveillance systems. A limitation is the potential for a degree of subjectivity in the application of the frameworks used to guide our synthesis. We were unable to locate all the questionnaires used in the most recent national surveillance systems listed on the country cards and some of the surveillance systems included within this study may have been updated or changed since this work was completed. In addition, although the GoPA! country cards provide an overview of global surveillance systems we acknowledge that some potentially relevant sources may be missing from the country cards and hence from our review. Lastly, our focus was on describing the characteristics of sedentary behaviour surveillance questionnaires. As such we did not consider the method of sample recruitment, obtained sample sizes or the validity and reliability of the

questions used, but acknowledge these are important considerations for obtaining representative prevalence estimates. The psychometric properties of self-report methods to assess sedentary behaviour has recently been reviewed elsewhere.¹⁷

Conclusion

From our review of sedentary behaviour assessment in population surveillance, we found that most countries are using a single item direct measure of sitting time to estimate their country level prevalence, and these tools are largely consistent with public health guidelines. The example behaviours provided, and the types of behaviours being measured, should be periodically reviewed in response to evidence on contemporary behaviour patterns in the population and the release of updated public health guidelines.

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Tables

Table 1. Global region and The World Bank income classifications for countries with included questionnaires.

Global Region	n	(%)
Africa	31	(23)
Eastern Mediterranean	11	(8)
Europe	42	(31)
Southeast Asia	9	(7)
The Americas and The Caribbean	19	(14)
Western Pacific	23	(17)
Income classification		
Low income	15	(11)
Lower middle-income	34	(25)
Upper middle-income	31	(23)
High income	55	(41)

Table 2. Questionnaire characteristics mapped onto the Taxonomy of Self-reported Sedentary Behaviour Tools (TASST); (n=104).

Taxonomy item		n	(%)
1	Type of assessment		
1.1	<i>Single item</i>	83	(80)
1.1.1	Direct measure	78	
1.1.2	Proxy measure	5	
1.2	<i>Composite item</i>	21	(20)
1.2.1	Pattern	0	
1.2.2	Sum	21	
1.2.2.1	Behaviours	17	
1.2.2.2	Domains	0	
1.2.2.3	Behaviours and domains	4	
2	Recall period		
2.1	Previous day	2	(2)
2.2	Previous week	31	(30)
2.3	Longer	6	(6)
2.4	Unanchored	65	(63)
3	Temporal unit		
3.1	Day	100	(96)
3.2	Week	4	(4)
3.3	Longer	0	(0)
4	Assessment period		
4.1	Weekdays only	14	(13)
4.2	Weekend days only	0	(0)
4.3	Both weekdays and weekend days	12	(12)
4.4	Subdivision of the day	2	(2)
4.5	Not defined	76	(73)

Table 3. Frequency of sedentary behaviour characteristics mapped onto the Sedentary Behaviour International Taxonomy (SIT); (n=93).

Facet	Category	Measured (n)	Examples (n)
Purpose			
	Work	60	63
	Leisure	21	1
	Travel	44	49
	Domestic	48	12
	Education	10	18
	Social	36	47
	Eating	0	2
	Rest	0	2
	Care	0	0
	Other	0	1
	Undetermined	11	8
	Total sitting	77	-
Type			
<i>Non screen</i>			
	Reading	3	63
	Writing	0	1
	Phone calls	0	0
	Driving/using public transport	3	49
	Eating	0	2
	Music	1	4
	Spiritual	0	0
	Household	0	0
	Other	0	39
<i>Screen</i>			
	TV	21	67
	PC	15	21
	Videogame	4	12
	iPad/Tablet/E-reader	7	5
	Smartphone	5	5
	Cinema	0	1
	Other	0	1

Undetermined

1

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Figures

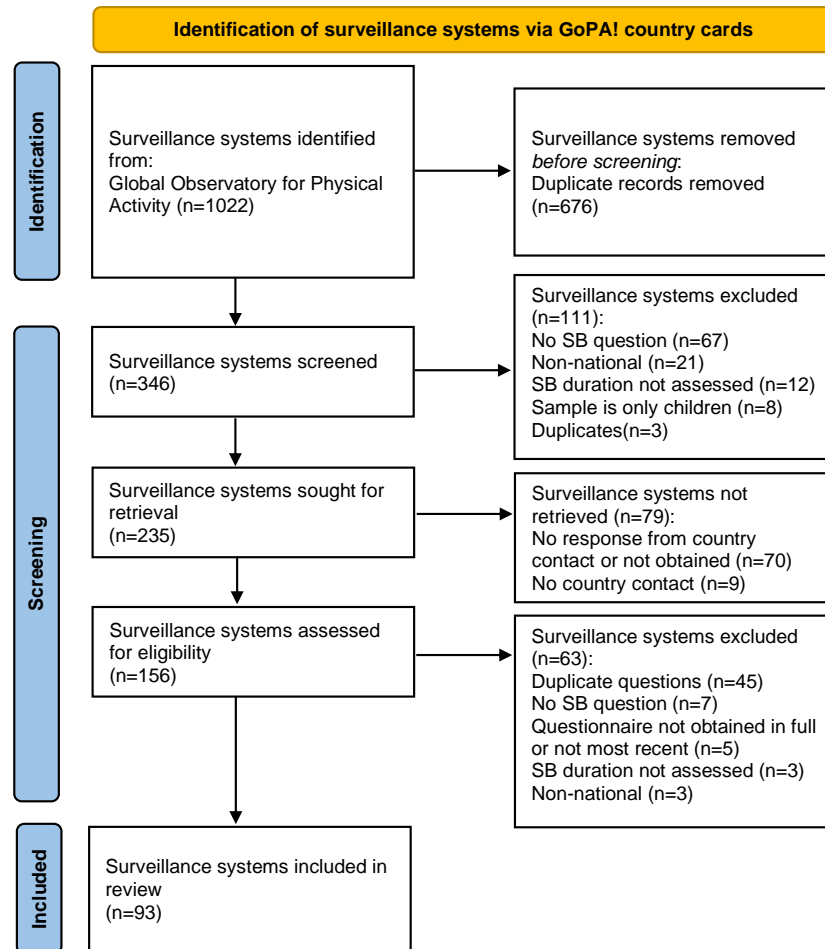


Figure 1. Adapted PRISMA flow diagram for depicting the process of surveillance systems selection.

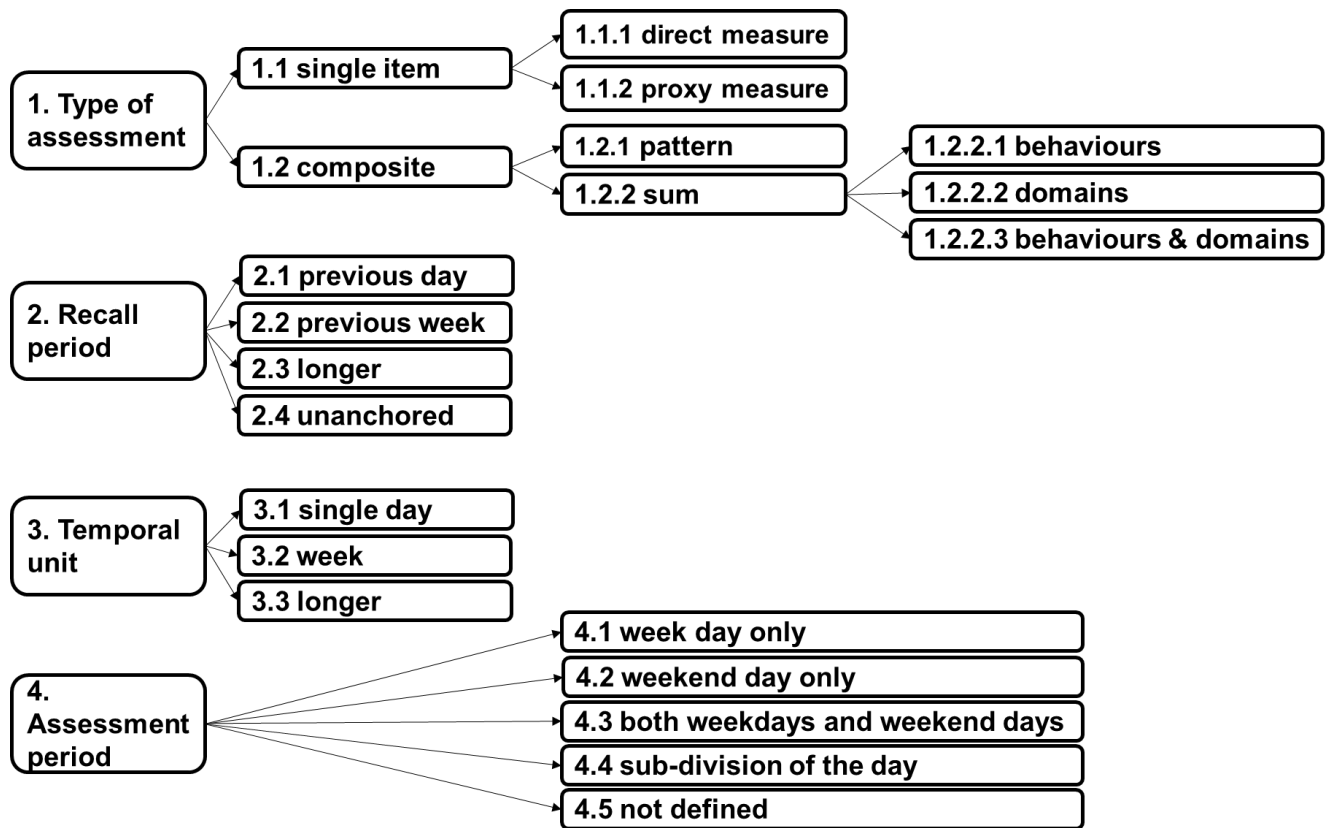


Figure 2. Modified Taxonomy of Self-reported Sedentary Behaviour Tools (TASST).

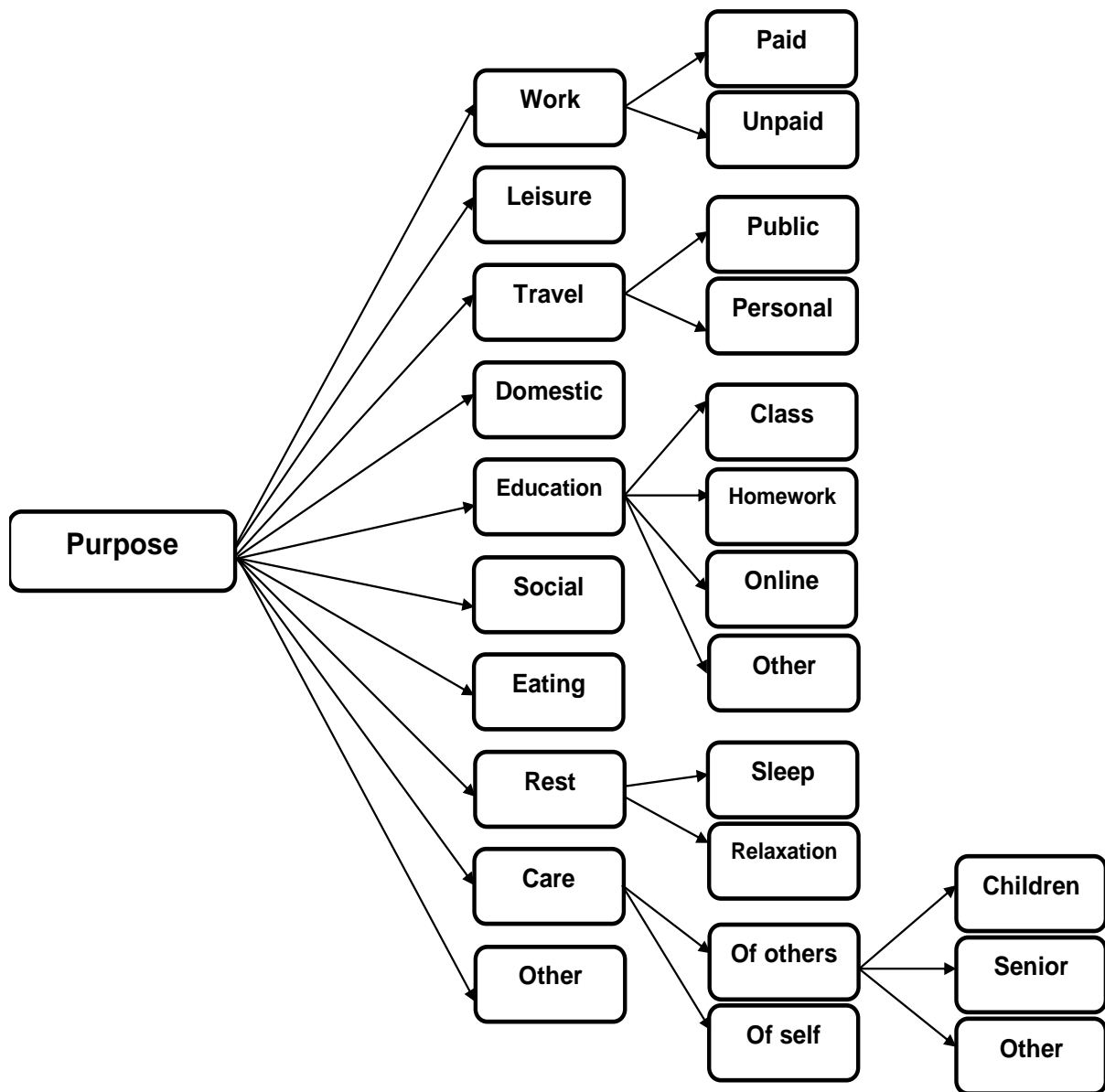


Figure 3. Purpose facet from the Sedentary Behaviour International Taxonomy (SIT).

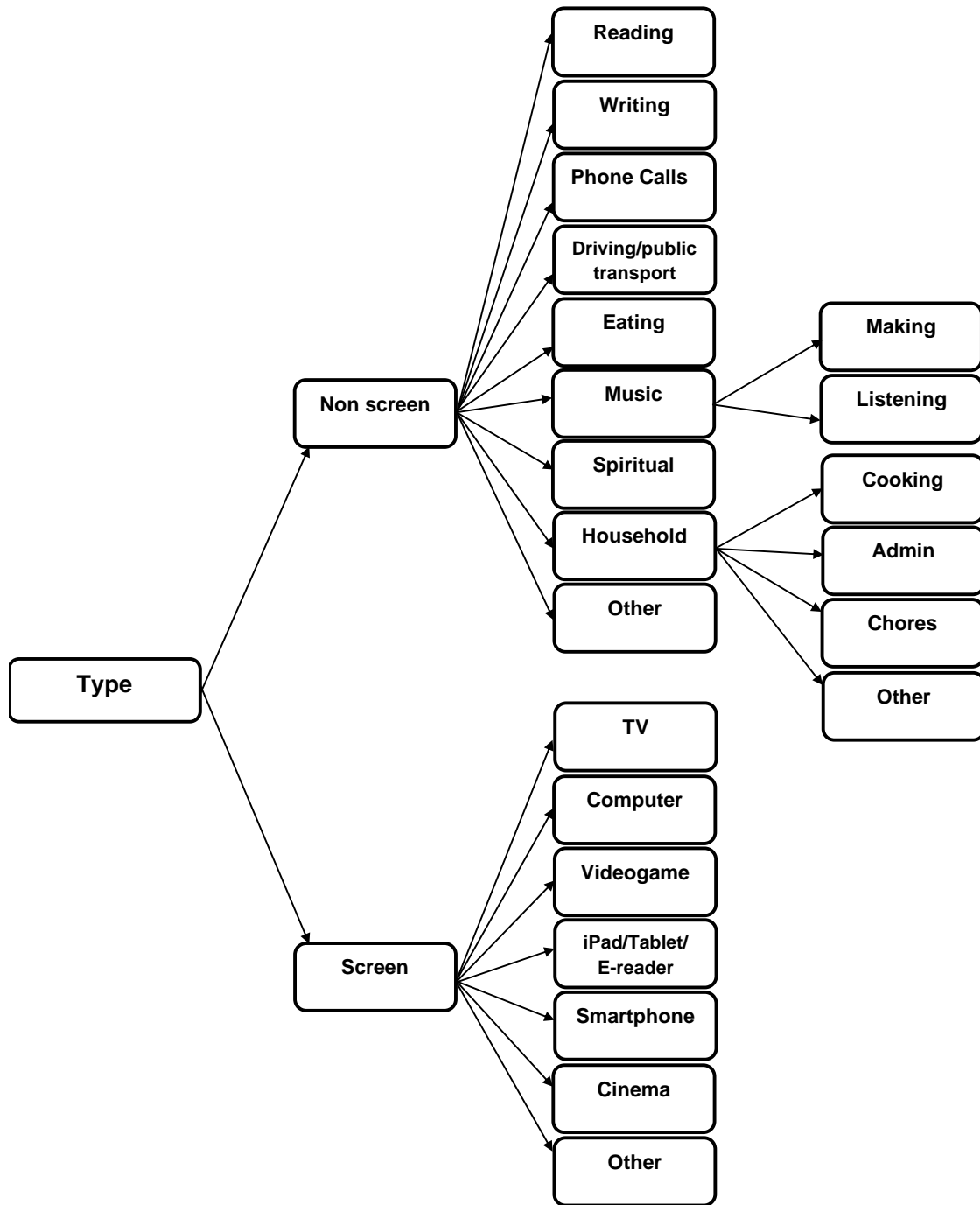


Figure 4. Adapted 'type' facet from the Sedentary Behaviour International Taxonomy (SIT).