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Environmental Profile of a Community's Health (EPOCH): An Instrument to Measure Environmental Determinants of Cardiovascular Health in Five Countries

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Abstract

Background: The environment in which people live is known to be important in influencing diet, physical activity, smoking, psychosocial and other risk factors for cardiovascular (CV) disease. However no instrument exists that evaluates communities for these multiple environmental factors and is suitable for use across different communities, regions and countries. This report describes the design and reliability of an instrument to measure environmental determinants of CV risk factors.

Method/Principal Findings: The Environmental Profile of Community Health (EPOCH) instrument comprises two parts: (I) an assessment of the physical environment, and (II) an interviewer-administered questionnaire to collect residents' perceptions of their community. We examined the inter-rater reliability amongst 3 observers from each region of the direct observation component of the instrument (EPOCH I) in 93 rural and urban communities in 5 countries (Canada, Colombia, Brazil, China and India). Data collection using the EPOCH instrument was feasible in all communities. Reliability of the instrument was excellent (Intraclass Correlation Coefficient - ICC > 0.75) for 24 of 38 items and fair to good (ICC 0.4–0.75) for 14 of 38 items.

Conclusion: This report shows data collection with the EPOCH instrument is feasible and direct observation of community measures reliable. The EPOCH instrument will enable further research on environmental determinants of health for population studies from a broad range of settings.

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Introduction

It is now generally accepted that the physical and social environment play an important role in influencing the diet, physical activity, smoking, and other health-related behaviours of adults and children.[1] These behavioural risk factors impact directly and indirectly, through intermediate conditions such as obesity, hypertension, abnormal lipid profiles and dysglycaemia, on a range of chronic diseases.

Many instruments have been developed to measure environmental factors that influence health-related behaviours, [2,3, 4,5,6,7,8] however most of these have focused on a single health behaviour such as smoking, physical activity or diet and on one aspect of the environment. For example, Joossen's Tobacco Control Scale assesses the presence of policies to reduce smoking but does not include other environmental measures such as social acceptability.[7,8] Instruments designed to measure various aspects of the 'food environment'[5] have looked at food stores,[9]

restaurants,[10] schools[11] or worksites.[12] Instruments measuring the physical activity environment are the best developed. These can be divided into objective (information obtained through systematic observation, audit or archival geographic data) [3,13] and subjective (obtained through questioning individuals on the perceptions of their environment).[2,4] A recent review of physical activity environment instruments identified 20 objective assessment tools and 19 perception-based questionnaires.[6] Measures included in both types of instrument include: the availability of walking infrastructure, neighbourhood crime and safety and presence of local government support e.g. funded parks but few research teams combine perception and objective measures.

Most of the instruments described in the literature have been developed and used in discrete geographic settings, typically in the United States,[14] Australia[15] or the United Kingdom[16] (exceptions are some instruments assessing tobacco policies)[7,17] and many are likely to be unsuitable or require significant cultural adaptation to be applied elsewhere and particularly in low or middle income countries. Few instruments have been used in rural areas. This is important given the sizeable rural populations in many countries in the world. In addition few have been subject to reliability testing and only one instrument that we identified has been tested for reliability in multiple countries.[18]

To enable a comparative examination of environmental factors and analysis of a broad range of conditions in which environmental factors are likely to be causal such as obesity, diabetes and cardiovascular disease, it will be necessary to develop instruments that measure multiple aspects of the environment in simple and reliable ways. We have been assessing methods that can measure environmental determinants of health in communities from diverse cultural, socioeconomic, and regional (urban and rural) settings of 17 countries as part of the Prospective Urban Rural Epidemiology (PURE) study. [19] As we note above, existing instruments have not been utilised in this range of settings. Within the limited resources of a large epidemiological study our aim was to create an instrument that could collect reliable and comparable data on environmental characteristics associated with cardiovascular risk factors across these diverse communities. This paper describes the design and testing of reliability of the EPOCH (Environmental Profile of a Community's Health) instrument.

Methods

EPOCH Instrument development

The EPOCH instrument was developed initially from a review of existing instruments and community level measures that influence cardiovascular risk factors (CVRFs) and this review has been described separately.[1] Four major domains were identified: the tobacco environment, the physical activity environment, the food (including alcohol) environment, and the social and economic environment. Within each domain a list of items that should be included in each was made. Thus items included in the tobacco environment domain were: price of cigarettes, smoke-free zones, tobacco advertising, support available for quitting, health warnings and other information on the harms of tobacco, access to tobacco generally and by youth and social acceptability of smoking. Items included in the physical activity domain were: availability and access to public transport, sidewalks, street lighting, safety of roads, aesthetics of community, availability of and access to local services including recreation facilities and parks, advertising for physical activity and policies and media promoting physical activity. Items included in the food environment were price of high and low nutrition foods, food advertisements, access to and availability of fruit and vegetables, policies and media promoting healthy diets,

food labelling. Some measures from the social and economic domains overlapped with other domains; additional measures collected here were other household expenditure such as housing, as well as measures of social support and social cohesion. As far as possible the measures included in the EPOCH instruments sought to be comprehensive within the constraints of an instrument that was practical and feasible to administer. After the pilot phase a few measures were dropped (e.g. the quality of parks, the extent of physical disorder) as these measures were difficult to assess objectively and concerns were raised by many of our in-country investigators that qualitative measures (e.g. Likert scales) would be difficult to compare across communities from different countries.

As the main aim was to create an instrument that was applicable to diverse cultural, socio-economic and regional (urban/rural) settings, researchers from a wide range of the PURE study countries were involved in an iterative process of instrument development. The measures and underlying concepts of the proposed instrument were discussed in a series of face-to-face meetings with investigators and data collectors from each country. From these meetings standard definitions and data collection methods were developed to ensure that our instrument captured the same concepts in each community. In some cases this involved identifying equivalents in different settings. For example stores that sell cigarettes may be stand-alone market stalls in some countries or parts of convenience stores or supermarkets in others. In some cases data collection was limited to basic items to ensure broad applicability. For example, a universal grocery list of common food items was created by identifying common foods from Food Frequency Questionnaires (FFQ) data collected for the main PURE study [20] and this was cross checked against lists of frequently consumed foods available by country from the Food and Agriculture Organisation (<http://faostat.fao.org/>).

Methods of data collection used in EPOCH

The instrument was developed in two parts: EPOCH 1 is an objective environmental audit tool in which trained researchers directly observe and systematically record physical aspects of the environment using a pro-forma, with standardized operational definitions. EPOCH 2 is an interviewer administered questionnaire that captures perceptions about the community from PURE subjects living in that community.

EPOCH 1 has five sections. The first, '*Community characteristics*', is a checklist of essential infrastructure and services in the community. The second, a '*Community observation walk*', takes place in a commercial or central shopping district that people use for everyday purchases. Its precise location is selected on the basis of local knowledge by study coordinators. Researchers walk according to a planned route covering 1 kilometre, beginning from a pre-specified central location designated as the 'start point' (e.g. a central busy traffic intersection, central train or bus station, post office, supermarket, shopping mall, school or other central area where people frequently visit). On the walk researchers count the different types of advertisements, shops and note other features of the community environment including the presence and quality of the sidewalk. The walk generally took about 1 hour.

The third section is '*Assessment of a tobacco retail outlet*' and the fourth is an '*Assessment of a grocery store*'. The aim of these assessments was to capture price, access to and availability of products, and presence of in-store advertising. The fifth section is an '*Assessment of a local restaurant*'. The closest tobacco store, grocery store and local restaurant to the 'start point' of the community observation walk were selected for the detailed assessments. If none existed, these were not done.

EPOCH 2 includes questions that aim to capture, (i) what participants observe in their community; (ii) their awareness of local laws, regulations, and health programs, and (iii) their opinions about behaviours and laws. For example, participants are asked where they have observed individuals smoking in their community or what types of advertisements (for and against smoking) participants have seen in different types of media. Questions are included on whether, in their communities, smoking is currently allowed, and their opinion of social acceptability of smoking.

The feasibility of using the EPOCH instruments was tested initially in 25 rural and urban communities in Brazil, Canada, China, Colombia and India. Quantitative and qualitative information from pre-testing was reviewed by three working groups involving international collaborators which led to further refinements of the instrument. Pre-testing also established the feasibility of data collection by research assistants with only 2 hours of training.

Data collection

To evaluate the performance of the EPOCH instruments, a convenience sample of 93 other urban and rural communities involved in the PURE study from China (Yunnan, Qinghai, Beijing, Jiangsu, Shandong, Shanxi, Shannxi, Jiangxi, Liaoning, Xinjiang, Sichuan provinces), India (Karnataka state), Colombia (Santander, Nariño, Quindio, Bolivar), Brazil (Sao Paulo, Angatuba, North region) and Canada (British Colombia, Ontario and Quebec) were selected. Communities in the PURE study were selected by local country investigators to align with administrative borders (such as census tracts or postal zones). For example in Canada community boundaries was based on an area (suburb or town) name and the corresponding cluster of postal codes. In rural areas in India, China or Colombia it was village boundaries. In urban areas, selected urban communities in each country were sampled across different local income strata to capture within country diversity (Table 1).[19]

Manuals and training slides were translated and distributed prior to a two hour training session. Face-to-face training was conducted in China, India and the Ontario site in Canada and training at these sites involved a session where all observers and the trainer visited at least one community together to do an assessment. Teleconference and web conferencing were used for other sites and in these sites community observers made at least one practice assessment prior to commencing the study. Three researchers from each recruiting site were trained to administer EPOCH I. Each assessment was undertaken independently at a similar time of day and within two weeks of the first assessment between May 2008 and March 2009. At the end of the study researchers were asked to give qualitative feedback on the conduct

and feasibility of data collection. EPOCH 1 and 2 instruments and manual of operations are available in Appendix S1, S2, S3. All training was conducted by the lead author.

Ethics statement. The EPOCH instruments were approved by the Hamilton Health Sciences/McMaster Health Sciences Research Ethics board. Written informed consent was obtained from all participants in the study.

Analysis

The inter-rater reliability of the objective component of the EPOCH tool across all communities and in major sub-groups was assessed. The EPOCH-1 reliability study was conducted in which a sample of k observers measured n community-level characteristics from 93 communities in the EPOCH pilot countries (Canada, India, China, Colombia, and Brazil). The j th independent assessment of the i th community-level characteristic, X_{ij} , is represented under the two-way random effects model as:

$$X_{ij} = S_i + M_j + F_{ij}, \quad (1)$$

Where S_i is the effect of the community-level characteristic (assumed to be normally distributed with mean 0 and variance σ_S^2); M_j is the random effect of assessment j , and F_{ij} is the random error associated with this particular community-level characteristic (assumed to be normally distributed with mean 0 and variance σ_F^2). Under this model, it is assumed that all variables are mutually independent and that there is no observer-by-community characteristic interaction [21]. The intraclass correlation coefficient (ICC) is given by:

$$ICC = \frac{\hat{\sigma}_S^2}{\hat{\sigma}_X^2} = \frac{n(SMS - EMS)}{nSMS + kMMS + (nk - n - k)EMS}, \quad (2)$$

where SMS, MMS, and EMS are the mean squares for community-level characteristics, assessments, and error respectively, obtained from the two way analysis of variance (ANOVA) design [22].

We classified ICC above 0.75 as excellent agreement and below 0.4 as poor agreement.[23] Reliability is reported for the entire group and was also calculated for sub-groups (urban communities versus rural, by country, and by country economic level).

Analyses were conducted using STATA version 11.0.

Results

Feasibility

In general, observers reported few problems. For EPOCH 1, they reported that the majority of items were “easy” to collect by observers and that assessments became easier with experience. In-person training and conduct of test community assessments with

Table 1. Characteristics of communities surveyed.

Characteristics	Brazil	Canada	China	Colombia	India
Number of communities	6	39	19	13	15
Rural (%)	50	33.3	26.3	42.9	66.7
Paved roads (%)	66.7	100	100	92.9	93.3
Traffic lights (%)	50	97	68.4	42.9	26.7
Highway in community allowing speeds >50 km/hr (%)	66.7	84.6	26.3	7.1	20.0
Availability of Internet access	50	100	94.4	100	26.7

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the trainer was helpful to discuss definitions and explain concepts, particularly in areas where English was not widely spoken. Observers in India asked about large seasonal variations in fruit and vegetable availability, while those in some communities from Canada raised questions regarding the price of housing. In Canada, secondary data sources usually only reported the average cost of residential housing for a larger district that may not correspond to the smaller community being evaluated. This variable was hence left missing for a number of Canadian communities. With EPOCH 2, interviewers noted differences in the understanding of the term ‘community’. Interviewers identified the need to include an introductory paragraph setting out how the “community” was defined.

EPOCH 1 items

The frequency of certain observations was consistent with prior expectations, giving face validity. For example the communities in China recorded the most tobacco advertisements and communities in Canada the least; communities in Canada and Colombia recorded the most snack food advertisements and communities in China and India the least. Communities from China also recorded the most outlets that sold cigarettes and communities from Canada the least. Communities in urban Canada reported the highest number of infrastructure and health facilities and communities from rural India and China the least. Communities in urban Canada also reported the greatest range of fruits and vegetables and communities in rural India and China the least. Incompleteness of items was often due to items being not available in communities. In India, there were no restaurants in 5 communities. A number of items could not be priced as they were not available including: international brand cigarettes, fruit in 3 communities in India and 1 community in China, and vegetables in 7 communities from India.

EPOCH 1 Reliability testing

Table 2 summarises the inter-rater reliability of environmental attributes for each section of EPOCH 1. Overall 24 of 38 variables had an ICC ≥ 0.75 , 14 of 38 had an ICC between 0.40 and 0.74 and 0 of 38 had an ICC < 0.40 .

Reliability across sub-groups of communities. Findings were similar across urban and rural communities with 63% and 71% of items, respectively, having excellent reliability (Table 3). As the instrument was developed in Canada we compared reliability in Canadian communities with others. 71% of Canadian communities had excellent reliability compared with 61% of other communities. We also examined whether findings were similar in China, India and South America (Colombia and Brazil) and found higher levels of reliability in India and poorer levels in South America (Table 3).

Item variability: (Appendix S4). In China one item – ‘sizes of cigarette packs available’ had poor reliability. For this question observers had to visit a store that sold cigarettes and record the different sizes of cigarette packs available; in China many outlets sell cigarettes and the availability of different cigarette pack sizes in any two or more outlets varied. For example smaller vendor stalls sell smaller packs or single cigarettes.

In India, the reliability coefficient could not be calculated for two items. These were ‘signs prohibiting smoking’ and ‘in-store smoking cessation promotion’. For the first variable, the majority of the communities reported this as zero, with only two communities identifying one sign that prohibited smoking. For the second variable, the majority of communities reported zero while two communities reported one.

In Brazil/Colombia 8 items had poor reliability. One item was the ‘Number of health warnings on cigarettes’. The poor reliability for this variable appeared to be for two reasons. First, there was a misunderstanding regarding whether this question asked about the number of health warning labels or the number of different types of labels. That is, if there were identical health warning labels on the front and back of a pack this should have been counted as 2 labels and not 1. This misclassification also caused the lower reliability recorded in Canada. We identified this problem after data collection was completed. The second issue was true variability in number of health warnings on packs. In Canada, cigarette packs generally have the same number of health warnings, however in Brazil and Colombia there was true variability across cigarette packs. Five of the eight variables with poor reliability were measurements of numbers of advertisements or health promotion signs (‘signs prohibiting smoking’, health promotion advertisements’, ‘alcoholic drink advertisements’). Some observers identified many more advertisements than others. The 2 other variables with poor reliability were, ‘Healthy menu options in restaurants’ and ‘Main salad or vegetarian dish options in restaurants’. This seemed to be mainly due to observers attending different restaurants and these measures were not similar across different restaurants.

EPOCH 2 administration

Researchers reported EPOCH 2 took between 10 and 20 minutes to administer and that the majority of questions were well understood with only occasional additional clarification being required. The variation that occurred across groups met expectations, for example few participants from Canada reported observing smokers smoking in public places in the last 6 months but in comparison many more participants from outside of Canada reported observing smoking in public places. Junk food advertising was prevalent through the different types of media in Canada but less prevalent in China and India. A large percentage of participants were aware of tobacco control policies in Canada compared to other countries. In India and China awareness of tobacco control policies was poorest in rural areas. Corresponding to this pattern, knowledge of the harms of smoking was greater in Canada and very low in India and China (Table 4).

Discussion

Our investigation indicates that the collection of community-level information using the EPOCH instruments was feasible and, for many variables, direct community observation had high inter-observer reliability in communities in the 5 countries studied. There are no previous published reports to our knowledge of instruments that profile communities using a wide range of environmental factors influencing cardiovascular risk factors. Very few community profiling instruments have been examined for reliability and validity. An additional unique strength to our instrument is that it is suitable for use in large-scale epidemiological studies in countries at different levels of economic development and urbanisation.

As we have noted above, the majority of existing environmental assessment instruments assess single behavioural risk factors such as physical activity[2,3,4] while Raudenbush’s “systematic social observation” work, which also uses community assessment, is restricted to the “social environment of the community”. [24] In some cases reliability has been assessed, but this has mainly been limited to assessment of inter-observer reliability. Brownson and colleagues found that measures of physical disorder and safety, which are often scored using a subjective measure or Likert scale,

Table 2. Reliability testing of measurements from the EPOCH I instrument.

Environmental attributes		ICC	95% CI	Number of communities
<i>Community demographics</i>				
1	Cost of residential land	0.86	(0.80, 0.91)	59
2	Number of public transportation services (sum of yes responses to a list of 4 services)	0.93	(0.90, 0.95)	93
3	Maximum daily frequency of public transportation (6 categories)	0.94	(0.92, 0.95)	92
4	Number of types of public services/education facilities (sum of yes responses to list of 5 services)	0.86	(0.81, 0.90)	93
5	Number of types of community infrastructure (sum of yes responses to a list of 5 facilities)	0.93	(0.90, 0.95)	93
6	Number of types of community health facilities (sum of yes responses to a list of 7 facilities)	0.87	(0.83, 0.91)	93
7	Sidewalk completeness and quality score (scale of 0 to 8)	0.94	(0.91, 0.96)	93
<i>Community observation walk</i>				
1	Number of tobacco advertisements	0.67	(0.57, 0.75)	93
2	Number of signs prohibiting smoking	0.97	(0.96, 0.98)	93
3	Number of health promotion advertisements	0.54	(0.42, 0.65)	93
4	Number of snack food advertisements	0.79	(0.72, 0.85)	93
5	Number of sugary drink advertisements	0.88	(0.83, 0.91)	93
6	Number of alcoholic drink advertisements	0.87	(0.82, 0.91)	93
7	Number of places to buy cigarettes	0.80	(0.73, 0.85)	93
8	Number of places to buy snack foods	0.86	(0.81, 0.90)	93
9	Number of stores selling food	0.88	(0.84, 0.92)	93
10	Number of places to buy alcohol	0.69	(0.60, 0.77)	93
11	Number of restaurants	0.95	(0.93, 0.96)	93
12	Number of parks and street trees	0.80	(0.74, 0.86)	93
<i>Tobacco store assessment</i>				
1	In-store tobacco advertisements (yes/no)	0.83	(0.77, 0.88)	93
2	In-store smoking cessation promotion (yes/no)	0.71	(0.62, 0.79)	93
3	Number of tobacco brands	0.67	(0.57, 0.76)	93
4	Number of sizes of cigarette packs available (5 categories)	0.73	(0.64, 0.80)	93
5	Price of cheapest pack of cigarettes	0.96	(0.95, 0.98)	93
6	Price of Marlboro or other international brand	0.97	(0.95, 0.98)	68
7	Number of health warnings on cigarette packs	0.64	(0.52, 0.73)	93
<i>Grocery store assessment</i>				
1	Point of sale unhealthy food advertising (yes/no)	0.66	(0.56, 0.75)	93
2	Point of sale healthy food advertising (yes/no)	0.62	(0.52, 0.72)	93
3	Fruit and vegetable display quality (scale 1 to 7)	0.69	(0.60, 0.77)	93
4	Number of types of fruits available (checklist of 48 types)	0.86	(0.80, 0.90)	93
5	Number of types of vegetables available (checklist of 59 types)	0.90	(0.86, 0.93)	93
6	Price of fruit	0.83	(0.77, 0.88)	89
7	Price of vegetables	0.91	(0.87, 0.93)	86
8	Price of other products	0.86	(0.81, 0.90)	93
<i>Restaurant assessment</i>				
1	Healthy menu options (yes/no)	0.50	(0.37, 0.62)	88
2	Main salad or vegetables dish (yes/no)	0.58	(0.47, 0.69)	88
3	Buffet service (yes/no)	0.64	(0.54, 0.74)	88
4	Option to increase portion size (yes/no)	0.49	(0.37, 0.61)	88

Note 1: *Public services/education facilities* is the number of facilities from a list of 6: primary/secondary school, university/technical college, post office, police station, government building, public park. *Community infrastructure* is the number of characteristics from a list of 5: paved roads, traffic lights, street lights, internet and highway. Similarly *Community health facilities* are the number of characteristics from a list of 6: Public nurse-only clinic, Public medical clinic, Private medical clinic, Public hospital, Private hospital, Pharmacy that sells medications.

Note 2: The low numbers of communities for: 'cost of residential land' was because this data was not able to be obtained in many communities in Canada; for 'Price of Marlboro' and Restaurant variables was mainly because International brand cigarettes were not available in some rural Indian communities and some rural communities also did not have restaurants.

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Table 3. Reliability by region of EPOCH 1 measures: Number and proportion (%) of all items with ICC in the following ranges (38 items in total).

Grouping	Number of communities	Items with ICC <0.4		Items with ICC 0.4 to 0.75		Items with ICC >0.75	
		N	%	N	%	N	%
All communities	93	0	0	14	36.8	24	63.2
Urban	56	0	0	14	36.8	24	63.2
Rural	37	0	0	11	28.9	27	71.1
Canada	39	0	0	11	21.1	27	71.1
Other countries	54	0	0	15	42.1	23	60.5
Brazil/Colombia	20	8	21.1	14	36.8	16	42.1
India	15	2*	5.3	1	2.6	35	92.1
China	19	1	2.6	20	52.6	17	44.7

*Intraclass Correlation Coefficient (ICC) for these two items was not able to be calculated as was equal to zero for the majority of communities in India.
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Table 4. Participant observations and perceptions of their community environment – responses to EPOCH 2.

Variable	Canada		China/India		Colombia/Brazil		All countries	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %
Participant observations								
Proportion reporting observing smokers smoking in public places ¹	5%	2%	48%	46%	38%	53%	28%	36%
Mean number of types of media where Tobacco advertisements seen (total 7 types)	1.4 (0.5)	1.2 (0.5)	1.4 (0.5)	0.8 (0.5)	3.4 (1.6)	2.7 (1.3)	1.9 (1.2)	1.4 (1.1)
Mean number of types of media where Junk food advertisements seen (total 5 types)	3.4 (0.5)	3.5 (0.7)	1.9 (0.8)	0.7 (0.5)	2.8 (0.8)	2.0 (0.7)	2.7 (1.0)	1.8 (1.3)
Mean number of types of media where Healthy food advertisements seen (total 5 types)	3.0 (0.3)	2.9 (0.7)	2.0 (0.9)	0.9 (0.6)	2.2 (0.6)	1.7 (0.6)	2.5 (0.8)	1.6 (1.0)
Participant opinions								
Proportion reporting intolerance to indoor smoking	22%	9%	26%	30%	21%	26%	23%	23%
Proportion reporting disapproval of youth smoking	73%	75%	87%	96%	61%	59%	76%	80%
Proportion reporting disapproval of adult smoking	46%	45%	39%	84%	40%	35%	42%	60%
Participant awareness								
Proportion reporting awareness of bans on smoking in public	93%	88%	44%	25%	45%	42%	64%	47%
Proportion reporting awareness of bans on tobacco advertising	81%	82%	41%	20%	42%	34%	58%	41%
Proportion reporting awareness of laws on health warnings	94%	96%	55%	37%	56%	53%	71%	57%
Proportion reporting awareness of bans on youth smoking	67%	61%	41%	17%	25%	30%	48%	33%
Proportion reporting awareness of laws on food/drink labelling	82%	71%	28%	15%	43%	29%	53%	34%
Participant knowledge								
Dietary causes of CVD ²	31%	23%	16%	11%	21%	18%	23%	16%
Smoking causes diseases ³	17%	24%	2%	7%	10%	7%	10%	12%

1. Percent of participants that reported seeing smokers smoke anywhere in the grounds in one or more of the following public places: hospital, trains/bus or train/bus stations, out-of home eating venues (restaurants, cafes or bars), indoor areas of workplace.

2. Percent of participants that respond correctly to all 10 questions regarding dietary causes of CVD.

3. Percent of participants that respond correctly to all 8 questions regarding the diseases associated with smoking and second-hand smoke exposure.

doi:10.1371/journal.pone.0014294.t004

tend to be less reliable compared to objective measures such as land use and physical street characteristics.[6] Few studies have evaluated the validity of environmental measures and virtually no instruments have been evaluated across communities in high-middle- and low-income settings. The only exception that we are aware of was a simple perceived measure of how environmental attributes may affect physical activity in adults in 11 countries including China, Brazil, and Colombia, for which test-retest reliability was examined.[18]

Given the growing evidence that environmental factors are related to a variety of cardiovascular risk factors, there is an urgent need for an instrument that can reliably quantify environmental factors in diverse communities. This is further supported by the rapid environmental transition that many low and middle income countries are experiencing which will likely impact chronic disease rates in those countries.

Unlike previous tools, our instrument assesses a composite of environmental factors, which is important from a public policy perspective as such factors influence several health-related behaviours. It has undergone numerous iterations to arrive at a set of measures that can feasibly be collected by research assistants following basic training in diverse communities. The reliability of the items measured by direct observation (EPOCH 1) is generally high. The instrument performed least well in Brazil and Colombia where 8 of the 38 items had low reliability. This seemed to be due mainly to: 1) measures being truly variable, for example cigarette packs did not have a uniform number of health warnings on them; 2) observers having different understandings of definitions, leading to identification of different numbers of advertisements. This may, however, reflect the lack of in-person training in the Colombian and Brazilian centres. It may be that improved face-to-face training would resolve this.

The qualitative feedback from observers was important in refining the instrument. Thus, some observers reported including pubs/restaurants that sell alcohol in 'Places to buy alcohol' and others included only specialty stores selling alcohol. Different assessments of point-of-sale advertising of healthy/unhealthy foods were due to confusion about the definition of 'point of sale'. Feedback from observers indicated that some only responded yes to 'point of sale' advertising if the advertisement was beside the cashier, while others responded yes if they observed advertising at any place at the front of the store. Observers also noted that identification of advertisements seems to improve as observers 'learn' where to look. We have subsequently improved our EPOCH manual and training materials to address these. We also now require trainers and auditors do at least one community assessment together to discuss observations, definitions and methods prior to actual data collection.

This study has some limitations. It was conducted in a convenience sample of communities in a small number of countries. We would encourage other groups that may be interested in using this instrument to assess instrument reliability in their setting prior to use. Practice in using the instrument is likely to improve reliability. We did not evaluate intra-observer

differences (i.e. the differences between repeat assessments by the same person on the same day of a community). It was expected that these would be very minimal due to the nature of the measures. We expected the main source of measurement error to be inter-observer differences. We also did not assess the test-retest reliability of the EPOCH 2 instrument of perceptions of environments and policies. The measures of the alcohol environment are limited to availability of places to buy alcohol and advertising in the community and omit measures of alcohol-related policy.

Conclusions

This report describes the design and development of an instrument to collect information about the community environment from a variety of settings and shows data collection with the EPOCH instrument is feasible and direct observation of community measures reliable. The EPOCH instrument will further research in the field of environmental determinants by making possible the examination of the nature and strength of the relationship between community-level factors and individual health for population studies from a broad range of settings.

Supporting Information

Appendix S1 EPOCH 1 instrument: Version August 21, 2008
Found at: doi:10.1371/journal.pone.0014294.s001 (0.04 MB PDF)

Appendix S2 EPOCH 2 instrument: version September 4, 2008
Found at: doi:10.1371/journal.pone.0014294.s002 (0.02 MB PDF)

Appendix S3 EPOCH manual: version September 8, 2008
Found at: doi:10.1371/journal.pone.0014294.s003 (0.28 MB PDF)

Appendix S4 Reliability testing by country
Found at: doi:10.1371/journal.pone.0014294.s004 (0.25 MB DOC)

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Author Contributions

Conceived and designed the experiments: CKC KL ABG SVS MM SY. Performed the experiments: CKC MM WL SS PLJ AA SL GD KKT. Analyzed the data: CKC DJC. Contributed reagents/materials/analysis tools: CKC. Wrote the paper: CKC KL ABG SL MM SY.

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Community ID

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Centre # Community#

Date:

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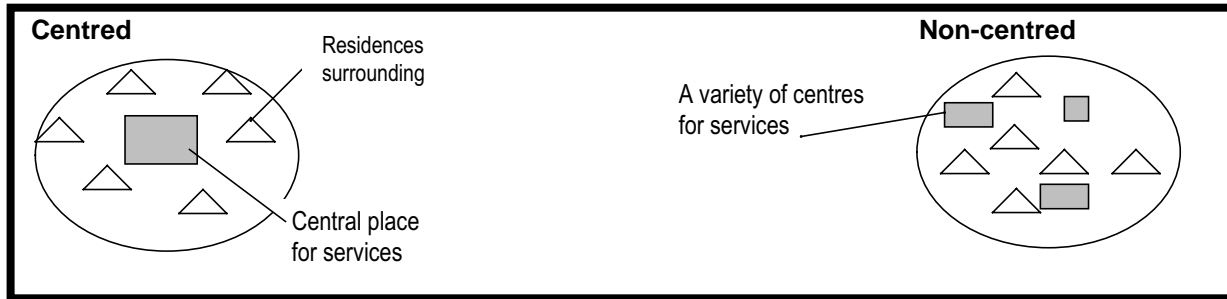
day month year

1. Was a map of the community obtained?

No Yes, map of route attached

a) Additional measures taken to define the community area:

2. Which statement best describes the arrangement of your community (check one only):



Centred Non-centred Other, please describe _____

Community Demographics (Please answer all prices in local currency)

3. Community name/s _____

4. Postal code/s of area

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5. Centre name _____

6. Cost per unit area of residential land

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 _____ Unit of measure
_____ Local currency

7. Is this community connected to other towns/cities with a network of transport e.g. bus, train or tram network?

No, there are no regular services (**Go to Question #8**)
 Yes, there is a regular service

a) What types of services are there? (mark all that apply)

Train Bus Shared Taxi Other, please specify _____

Community ID

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Centre # Community#

b) What is the maximum frequency per day of any regular services? (Mark one box only)

- | | |
|--|---|
| <input type="checkbox"/> 2 or more times per hour (20 or more times per day) | <input type="checkbox"/> 2 to 4 times per day |
| <input type="checkbox"/> Hourly (10 to 19 times per day) | <input type="checkbox"/> Daily |
| <input type="checkbox"/> 5 to 9 times per day | <input type="checkbox"/> Less than once a day |

8. Do the following facilities exist in this community?

- | No | Yes | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Supermarket where you can buy food supplies |
| <input type="checkbox"/> | <input type="checkbox"/> | Free Market (China only) |
| <input type="checkbox"/> | <input type="checkbox"/> | General store/ Convenience store |
| <input type="checkbox"/> | <input type="checkbox"/> | Market store (e.g. bakery, butcher, fruit market) |
| <input type="checkbox"/> | <input type="checkbox"/> | Store that sells tobacco/ cigarettes |
| <input type="checkbox"/> | <input type="checkbox"/> | Restaurant/ cafe/ fast-food outlet - place where one can buy food and sit down and eat it in an establishment outside the home |
| <input type="checkbox"/> | <input type="checkbox"/> | Take out store/ Street store/ coffee or food cart/ Tea shop/ Food stand - place where you can buy food - but there is no place to sit down . |
| <input type="checkbox"/> | <input type="checkbox"/> | Vending machine - where you can buy snack foods/ soft drinks |
| <input type="checkbox"/> | <input type="checkbox"/> | Vending machine - where you can buy cigarettes |
| <input type="checkbox"/> | <input type="checkbox"/> | Primary or Secondary School |
| <input type="checkbox"/> | <input type="checkbox"/> | College/ University/ Post-secondary Technical college |
| <input type="checkbox"/> | <input type="checkbox"/> | Post office |
| <input type="checkbox"/> | <input type="checkbox"/> | Police station |
| <input type="checkbox"/> | <input type="checkbox"/> | Government building accessible to community (e.g. community centre, library) |
| <input type="checkbox"/> | <input type="checkbox"/> | Public Park/ recreational area/ gardens |
| <input type="checkbox"/> | <input type="checkbox"/> | Paved roads |
| <input type="checkbox"/> | <input type="checkbox"/> | Electrical street lighting |
| <input type="checkbox"/> | <input type="checkbox"/> | Internet access enabled |
| <input type="checkbox"/> | <input type="checkbox"/> | Traffic lights |
| <input type="checkbox"/> | <input type="checkbox"/> | Factory |
| <input type="checkbox"/> | <input type="checkbox"/> | A highway - where cars can exceed speeds of 50km/ hour |

Community ID

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Centre # Community#

9. Do the following health care facilities exist in this community?
(Public refers to government run)

No Yes

- Public nurse-only clinic
- Public medical clinic
- Private medical clinic
- Public hospital (Government hospital)
- Public sector hospital (Hospital for employees) **(India only)**
- Private hospital
- Chemist/ pharmacy that sells medications

10. Is this a rural community?

- No, **(Go to Question #13, Next section Community Observation Walk)**
- Yes, **(Go to Question #11, Additional questions for rural communities)**

Additional questions for Rural Communities

11. What is the estimated distance from the centre of this community area to each of the following (in Kilometers)?
Note: If a railway station/ other transport/ tarred roads exist **within** the boundaries of this community, put zero kilometers.

- a) Nearest city/ major urban centre

--	--	--	--

 .

--

 km
- b) Nearest national state highway

--	--	--	--

 .

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 km
- c) Nearest long distance bus station

--	--	--	--

 .

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 km
- d) Nearest railway station with passenger trains stopping at least twice per day

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 .

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 km

12. What is the approximate travel time (in minutes) to travel from the centre of this community to the following (during regular working hours)?

- a) Nearest city/ major urban centre on public transport

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 minutes
- b) Nearest city/ major urban centre in a motorized vehicle

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 minutes

Community ID

Centre # Community#

COMMUNITY OBSERVATION WALK

13. Record today's date: day month year

Start Time (00:00-23:59)

14. The Start point:

a) Which description best describes the central start point (Mark one only)

- Central busy intersection, Market, Central train station, Shopping mall, Central bus station, School, Post office, Other - please specify, Supermarket or general store/ convenience store

b) What is the address of the start point?

i) Street No., ii) Street Name, iii) Cross street, iv) Latitude, v) Longitude, vi) Total distance: walked (meters)

15. Was a pre-planned route obtained? No Yes, route drawn or attached to page 5

16. Sidewalk completeness and quality

a) Please indicate which best describes the completeness of the sidewalk on your route. (Mark one only)

- No sidewalk, Partial sidewalk (sections with no sidewalk), Complete sidewalk on one side, Complete sidewalk on both sides

b) Give a rating between 1 and 4 for the quality of the sidewalk on your route. (Score 1 - if poorly maintained, score, 4 if well maintained)

Community ID

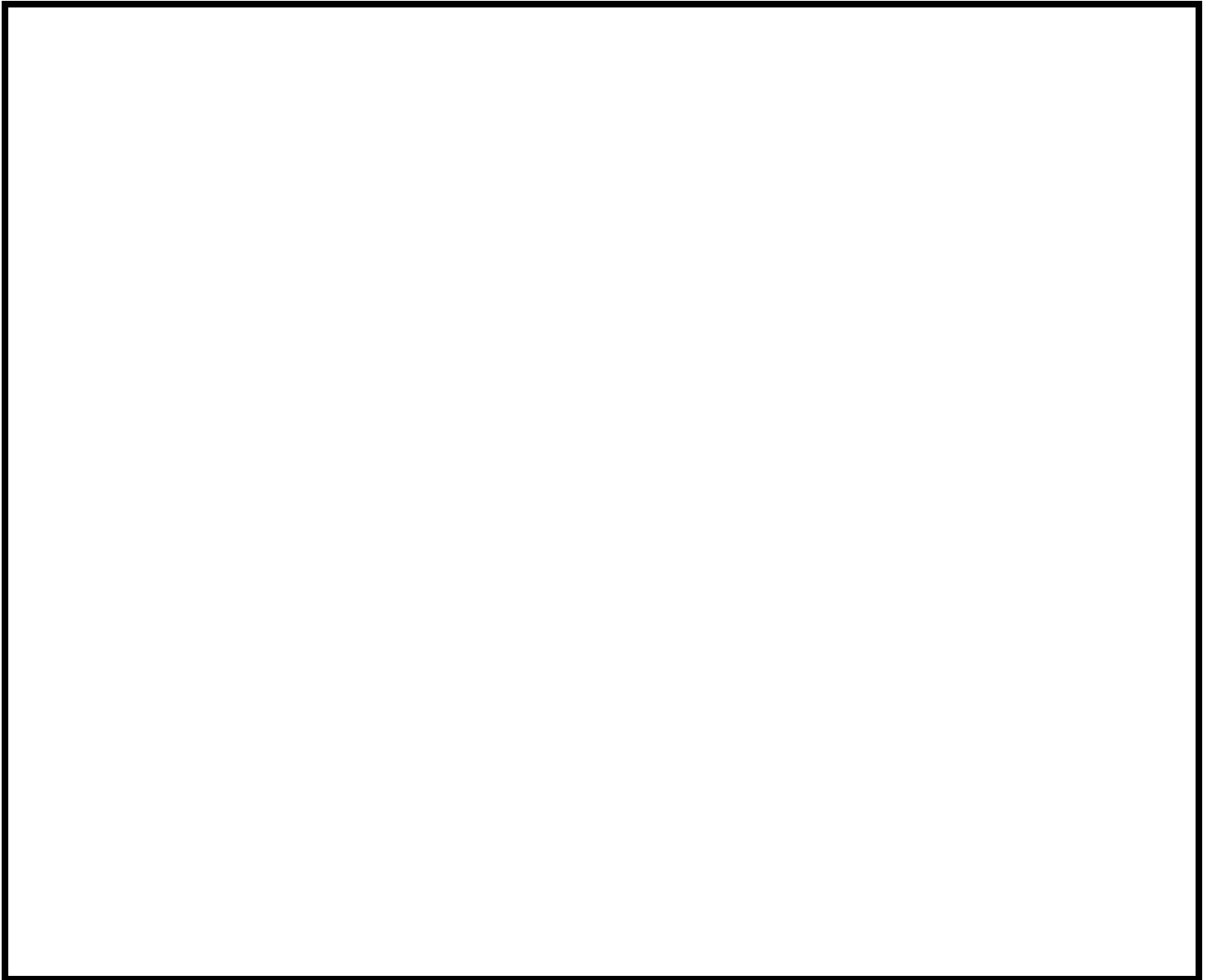
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Centre #

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Community#

Pre-planned route:



Observational walk

Follow the instructions exactly on community observation to assess this community environment for advertisements and availability of local shops/public places and document in the following tables.

Walk down the street for approximately 300 to 500 meters then cross the road and return walking back on the other side of the street returning to the spot opposite from where you started on the other side.

As you walk, look around you for advertising (e.g. billboards, posters, signs on shops, walls, bus stop shelters, advertisements on buses/cars etc.) and the types of shops. Each time you see one of the advertisements types or shops of interest listed below, mark a check or line in the Tally column.

At the end of your walk, total the tally columns for each row.

Photographic assessment

A series of photos will assist us in qualitatively comparing neighbourhoods and will also assist communities in identifying the locations researchers have assessed. We suggest the following photographs to be included in your assessment. Please carefully label all your photos with the date and community ID number.

- a. Photo of the street scene in each direction from the **start point** (a minimum of 4 photos)
- b. Examples of **advertisements** that are classified in question 17a (please include one photo of each category of advertisement that is identified on your community observation walk)
- c. Outside/Front of shop of the **tobacco shop** visited
- d. Outside/Front of shop of the **grocery store** visited
- e. Photo of **fruit and vegetable display** in the shop or in the stall (a minimum of 2 photos, 1 of fruits and one of vegetables)

Community ID

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Centre # Community#

17a) Advertisements	<u>Tally of Advertisements</u>	<u>Total</u>
i) Cigarette/tobacco product		□ □
ii) Signs that prohibit smoking		□ □
iii) Health promotion (smoking cessation)		□ □
iv) Health promotion (alcohol cessation)		□ □
v) Snack food		□ □
vi) Sugary drink (eg Coke, juices, sports drink)		□ □
vii) Non-commercial Health promo (diet)		□ □
viii) Commercial Health promo (diet)		□ □
ix) Non-commercial Health promo (Phys Act)		□ □
x) Commercial Health promo (Phys Act)		□ □
xi) Alcoholic drinks		□ □
17b) Shops		
i) Vending machines (cigarettes)		□ □
ii) Vendors/street stands (cigarettes)		□ □
iii) Convenience /general store (cigarettes)		□ □
iv) Vending machines (snack foods)		□ □
v) Vending machines (sweet drinks)		□ □
vi) Vendors/street stands/snack food shops		□ □
vii) Convenience/general store (no cigarettes)		□ □
viii) Supermarket		□ □
viii) Free market (China)		□ □
ix) Fruit & vegetable store/market		□ □
x) Butcher/meat store/market store		□ □
xi) Bakery		□ □
xii) Deli/other speciality food store		□ □
xiii) Alcohol speciality stores		□ □
xiv) Fast food restaurants		□ □
xv) Cafes/fast casual restaurants		□ □
xvi) Pubs/bars		□ □
xvii) Sit down restaurants		□ □
17c) Public Places		
i) For recreation/ physical activity		□ □
ii) Street trees/street flower beds		□ □

Community ID

Centre # Community#

TOBACCO STORE ASSESSMENT

18. Identify an outlet that sells cigarettes/smoked tobacco on your walk. If none available, walk to nearest place that sells cigarettes. If more than one available, visit the first store identified.

What is the street location of this spot and nearest main cross street? (Take a photo of the front of the tobacco store)

a) Distance from start point: (Meters) b) Street number: c) Street name: d) Main cross street:

19. Referring to the above store, do you see any of the following:

No Yes Point-of-sale tobacco advertising Cigarettes/smoked tobacco openly displayed (can you see cigarettes without requesting to buy them) Signs that prohibit smoking in the store Signs/information regarding the harmful effects of smoking visible on entering the store/ approaching the counter

20. How many brands of cigarettes are sold in this store?

20a) How many brands of beedis are sold in this store?(India)

20b) How many brands of chewing tobacco are sold in this store?(India)

21. In what size packets are cigarettes sold in this store? (Mark all that apply)

Singles Units 2-10/pack 11-19/pack 20 - 24/pack 25 or more/pack

22. Record the cost of a pack of the cheapest cigarettes and a pack of Marlboro. If no Marlboro, use other international brand. If there is a variety of pack sizes, record the cost, in local currency, of a pack of 20. (or pack nearest to 20 units)

Brand Price Number in Pack a) Cheapest pack b) Marlboro (or other international brand)

23. Buy the "local brand of cigarettes" priced above and send packet back to project office.

a) Is there a health warning on the packet? No Yes, answer 23b and c

b) What is the location of the warning on the packet? (Check all that apply)

Front Back Side Top Bottom

c) Transcribe the warning and translate into English here:

Blank lines for transcribing the warning.

Community ID

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Centre # Community#

GROCERY STORE ASSESSMENT

24. Which best describes the food purchasing environment in this community? (Mark one only)

- Supermarket- where all groceries are sold under one roof
- Cluster of small stores/market stores clustered together in a defined permanent market area
- Discrete stores that are permanent and specialize in separate groceries (eg.butcher,bakery etc)
- Combination of discrete permanent stores and non-permanent/seasonal street vendors
- Multiple street vendors not housed in a building or permanent store

25. Mark the type of store or stores you need to visit to buy the items listed in Q28. (Mark all that apply)

- | | |
|---|---|
| <input type="checkbox"/> Supermarket | <input type="checkbox"/> Baker |
| <input type="checkbox"/> General store | <input type="checkbox"/> Other food store _____ |
| <input type="checkbox"/> Fruit and vegetable store | <input type="checkbox"/> Other food store _____ |
| <input type="checkbox"/> Cluster of street vendors or market stores | <input type="checkbox"/> Other food store _____ |
| <input type="checkbox"/> Butcher | |

26. Visit the store/ supermarket to obtain food prices. What is the location of the grocery store?
(Photograph the front of the store)

- a) Distance from the start point:
(Meters)
- b) Street number:
- c) Street name: _____
- d) Main cross street: _____

27. Referring to this store, assess for the presence of the following:
(If more than one refer to closest store)

- | No | Yes | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Advertisements at the point of sale for snack foods |
| <input type="checkbox"/> | <input type="checkbox"/> | Advertisements at the point of sale for sugary drinks |
| <input type="checkbox"/> | <input type="checkbox"/> | Advertisements at the point of sale for fruits and/or vegetables |

Community ID

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Centre # Community#

29. What types of fruit were available in this store/ group of stores you have attended? (Check all that apply)

- | | | |
|---|--|---|
| <input type="checkbox"/> Apple | <input type="checkbox"/> Orange | <input type="checkbox"/> Lychee (East Asia) |
| <input type="checkbox"/> Apricots | <input type="checkbox"/> Papaya/ Paw paw | <input type="checkbox"/> Pomelo/Shaddock (East Asia) |
| <input type="checkbox"/> Avocado | <input type="checkbox"/> Peach | <input type="checkbox"/> Shan Zhu (East Asia) |
| <input type="checkbox"/> Banana | <input type="checkbox"/> Pear | <input type="checkbox"/> Cape gooseberry (S. America) |
| <input type="checkbox"/> Cantalope | <input type="checkbox"/> Persimmon | <input type="checkbox"/> Coconut (S. America) |
| <input type="checkbox"/> Cherries | <input type="checkbox"/> Pineapple | <input type="checkbox"/> Curuba (S. America) |
| <input type="checkbox"/> Dates (fresh) | <input type="checkbox"/> Plum | <input type="checkbox"/> Granadilla (S. America) |
| <input type="checkbox"/> Fig | <input type="checkbox"/> Pumpkin | <input type="checkbox"/> Lulo (S. America) |
| <input type="checkbox"/> Grapefruit | <input type="checkbox"/> Raspberries | <input type="checkbox"/> Passion fruit (S. America) |
| <input type="checkbox"/> Grapes | <input type="checkbox"/> Strawberries | <input type="checkbox"/> Soursop (S. America) |
| <input type="checkbox"/> Guava | <input type="checkbox"/> Other berries | <input type="checkbox"/> Tamarillo (S. America) |
| <input type="checkbox"/> Honeydew Melon | <input type="checkbox"/> Watermelon | <input type="checkbox"/> Tamarind (S. America) |
| <input type="checkbox"/> Kiwi | <input type="checkbox"/> Custard Apple (East Asia) | <input type="checkbox"/> Zapote (S. America) |
| <input type="checkbox"/> Lemon/ Lime | <input type="checkbox"/> Fire Dragon fruit (East Asia) | <input type="checkbox"/> Jamun (South Asia) |
| <input type="checkbox"/> Mango | <input type="checkbox"/> Jackfruit (East Asia) | <input type="checkbox"/> Pomegranate (South Asia) |
| <input type="checkbox"/> Nectarine | <input type="checkbox"/> Longan (East Asia) | <input type="checkbox"/> Sweet Lime (South Asia) |

30. Answer the following questions with regard to the fruit display in the store (or first store if multiple) that you visited to price fruit. (Photograph the fruit display to capture quality of fruit available in the shop)

- a) Are the fruits in this store easily visible from the outside of the store? No Yes
- b) Do more than 3 kinds of fruits appear to be damaged (bruised, rotten, or of poor quality)? No Yes
- c) Have more than 3 kinds of fruits in this store been specially packaged, wrapped or boxed for sale? No Yes

Community ID

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Centre # Community#

31. What types of vegetables were available in this store/ group of stores you have attended? (Check all that apply)

- | | | |
|--|---|---|
| <input type="checkbox"/> Alfalfa sprouts | <input type="checkbox"/> Kale | <input type="checkbox"/> Ipomoea (East Asia) |
| <input type="checkbox"/> Artichokes | <input type="checkbox"/> Leek | <input type="checkbox"/> Kalimeris indica (East Asia) |
| <input type="checkbox"/> Asparagus | <input type="checkbox"/> Lettuce | <input type="checkbox"/> Kohrabi leaf (East Asia) |
| <input type="checkbox"/> Beets | <input type="checkbox"/> Mushrooms | <input type="checkbox"/> Snow Pea/Holland beans (East Asia) |
| <input type="checkbox"/> Bok Choi | <input type="checkbox"/> Mustard Greens | <input type="checkbox"/> Sponge gourd, loofa (East Asia) |
| <input type="checkbox"/> Broad(Lima) beans | <input type="checkbox"/> Okra/lady finger | <input type="checkbox"/> Winter Melon (East Asia) |
| <input type="checkbox"/> Broccoli | <input type="checkbox"/> Onions | <input type="checkbox"/> Chard (S. America) |
| <input type="checkbox"/> Brussel Sprouts | <input type="checkbox"/> Other Chinese green vegetables | <input type="checkbox"/> Kusk (S. America) |
| <input type="checkbox"/> Cabbage | <input type="checkbox"/> Parsnips | <input type="checkbox"/> Bitter gourd (South Asia) |
| <input type="checkbox"/> Carrots | <input type="checkbox"/> Peas | <input type="checkbox"/> Bottle gourd (South Asia) |
| <input type="checkbox"/> Capsicums/Peppers | <input type="checkbox"/> Radish | <input type="checkbox"/> Chow Chow (South Asia) |
| <input type="checkbox"/> Cauliflower | <input type="checkbox"/> Spinach | <input type="checkbox"/> Colacasia (South Asia) |
| <input type="checkbox"/> Celery | <input type="checkbox"/> Squash | <input type="checkbox"/> Drumstick (South Asia) |
| <input type="checkbox"/> Chinese cabbage | <input type="checkbox"/> Tomatoes | <input type="checkbox"/> Green leafy (South Asia) |
| <input type="checkbox"/> Collards | <input type="checkbox"/> Turnips | <input type="checkbox"/> Karamani (South Asia) |
| <input type="checkbox"/> Corn | <input type="checkbox"/> Zucchini | <input type="checkbox"/> Other sprouts (South Asia) |
| <input type="checkbox"/> Cucumber | <input type="checkbox"/> Bean sprouts -Mung (East Asia) | <input type="checkbox"/> Ridge gourd (South Asia) |
| <input type="checkbox"/> Eggplant/Brinjal | <input type="checkbox"/> Bean sprouts -Soy (East Asia) | <input type="checkbox"/> Snake gourd (South Asia) |
| <input type="checkbox"/> Gourd | <input type="checkbox"/> Chrysanthemum (East Asia) | <input type="checkbox"/> Ulam (Malaysia) |
| <input type="checkbox"/> Green beans | <input type="checkbox"/> Cowpea (East Asia) | |

32. Answer the following questions with regard to the vegetable display in the store (or first store if multiple) that you visited to price vegetables. (Photograph the vegetable display to capture quality of fruit available in the shop)

- a) Are the vegetables in this store easily visible from the outside of the store? No Yes
- b) Do more than 3 kinds of vegetables appear to be damaged (bruised, rotten, or of poor quality)? No Yes
- c) Have more than 3 kinds of vegetables in this store been specially packaged, wrapped or boxed for sale? No Yes

Question #38 -

Sit down Restaurants - offers full table service by wait staff who take your order at the table, menu provided.

Bars/Pubs - sells a full range of alcoholic beverages, may have large quantity of alcohol advertisements

Fast casual restaurant - similar to fast-food in that it does not offer table service but promises somewhat higher quality of food and atmosphere. You may order and pay at a counter. Often food is brought to table.

Fast food restaurant - These are characterized by minimal service and by food that is supplied quickly after ordering. Food is commonly cooked in bulk in advance and kept hot, or reheated to order. Fast food is often finger food that can be eaten quickly without cutlery.

Outdoor food stall, with seating, selling pre-cooked or food cooked to order, with minimal or no facilities.

Community ID

Centre # Community#

RESTAURANT ASSESSMENT

36. Identify a typical low cost sit-down restaurant (inside or in the street) using the first available option in the list below.

- Closest to the starting point within the streets immediately surrounding (1000 meter radius)
Closest to supermarket/ grocery stores within the streets immediately surrounding (1000 meter radius)
Other location

37. What is the location of this restaurant and nearest main cross street?

a) Distance from start point: (Meters)
b) Street number:
c) Street name:
d) Main cross street:

38. What type of restaurant is it? See facing page for descriptions (Mark one only)

- Sit down Fast food
Bars/Pubs Outdoor food stall
Fast casual Other, please specify

39. In the restaurant or restaurant area:

- Do signs/ table information/menus highlight healthy menu options?
Does the menu include any main dish salads or vegetable dishes?
Is there a buffet service available in this restaurant?
Are there options in this restaurant to increase the portion size of your meal for a small price?

Obtain a copy, transcribe or photograph the menu in this restaurant. Take this menu to the office and transcribe and translate each item into English.

40. Name of Interviewer: (please print) First Initial Last Name End time: (00:00-23:59)