



WELL Country Briefs™:  
**AUSTRALIA**



INTERNATIONAL  
**WELL**  
BUILDING  
INSTITUTE™

# OVERVIEW

The International WELL Building Institute™ (IWBI™) is leading the global movement to transform our buildings and communities in ways that help people thrive. Through the ongoing development and delivery of the popular [WELL Building Standard™](#) (WELL™) – including the [WELL v2™ pilot](#) and the [WELL Community Standard™](#) pilot – IWBI is focused exclusively on the ways that buildings and communities can improve our comfort, drive better choices, and generally enhance our [health](#) and [wellbeing](#). IWBI convenes and mobilises people through management of the WELL AP™ credential, the development of educational resources, and advocacy for policies that promote health and [wellbeing](#) everywhere.

We also support the pursuit and dissemination of research to help us better understand how building design, performance, and operations influence health, and to advance the highest level of design, construction, and maintenance practices. One of the ways we do this is through our WELL Country Briefs™ series. The Country Briefs link WELL v2 features to national health data on the mortality and disability from diseases and injuries that arise due to the major [risk factors](#) compiled by the [Global Burden of Disease Study](#) (GBD) from the Institute of Health Metrics and Evaluation (IHME) at the University of Washington. By connecting WELL v2 features to the largest and most comprehensive dataset used by policymakers worldwide, we assist project teams in building WELL scorecards that address nationally important health issues in the locations in which they work.

# EXECUTIVE SUMMARY

Trends in population health vary by the locations in which they occur. Understanding and addressing public health concerns accurately and effectively requires a locally attuned approach to health interventions.

The IWBI has developed a series of WELL Country Briefs to help bridge the connection between globally available national data on health trends and WELL. WELL advances the idea that the way buildings are designed, constructed and operated are powerful opportunities to positively impact human health and wellbeing.

This Country Brief identifies building-level solutions that address top public health concerns in Australia based on national [epidemiological indicators of health](#), from the most well-respected public health dataset in the world: The Global Burden of Disease Study.<sup>1</sup>

The GBD Study from the Institute of Health Metrics and Evaluation at the University of Washington provides national-level health data for countries around the world by estimating death and disease burden and their associated risk factors. By linking features in WELL with risk factors identified in the GBD based on national [epidemiological](#) data, this Country Brief provides a possible prioritisation of features for Australian projects.

Due to the many factors that influence both health risks and effective health interventions for a given population, national epidemiological data should be considered as one of several factors that might influence a project team's decision on which features to pursue in WELL.

It is also important to note that trends identified in national data may differ from trends identified in local data or in building-level data. However, national-level data is currently available in a more consistent form around the world than local data, and as such the use of national-level data is a major first step we have taken towards developing regional customisation pathways within WELL.

## INTRODUCTION TO WELL

Public health researchers and practitioners have long recognised the impact of our buildings and communities on human health and wellbeing.<sup>2</sup> For example, over the last several decades, car-oriented urban and suburban developments have been shown to negatively impact a wide range of health outcomes, including increased traffic injuries and fatalities,<sup>3</sup> increased air pollution that has been linked to the global burden of respiratory diseases and allergies,<sup>4</sup> and rates of physical activity which play a significant role in chronic disease development, including heart disease, stroke and some cancers.<sup>5</sup> **Food deserts** – neighbourhoods with limited access to healthy, affordable food – also have been shown to negatively influence dietary patterns and health.<sup>6</sup>

At a building level, while building design, construction, operations and maintenance are important pieces of the overall health puzzle,<sup>7</sup> they have received little attention in public health compared to topics in urban planning.<sup>8</sup> Some key exceptions have been research on the role of inadequate ventilation as well as the off-gassing of chemicals, both of which have been linked to the occurrence of **sick building syndrome** (SBS) among occupants.<sup>9</sup> Poor indoor air quality and inadequate ventilation have also been linked to an increased risk of infection; radon and formaldehyde have been linked to adverse health outcomes;<sup>10</sup> and inadequate ventilation has been linked to poor productivity.<sup>11</sup> More recently, there have been promising advancements in research on building elements such as light exposure and its effects on our biological rhythms<sup>12</sup> and mood, as well as the impact of sound on sleep<sup>13</sup> and focus.<sup>14</sup>

WELL is the world's first building rating system focused primarily and exclusively on creating environments that enhance human health. It promotes buildings as spaces for **health interventions** with the understanding that buildings represent places where we spend approximately 90% of our time.<sup>15</sup> WELL therefore treats buildings as opportunities to deliver health benefits to the people inside. This is done through a combination of active interventions (e.g., the provision of healthy food and stairs to encourage behaviour changes in consumption and in sedentariness) and interventions that occur in the background but affect every person in the building (e.g., the provision of good air and water quality in interior environments). Both types of interventions captured in WELL represent evidence-based strategies for health promotion.

## INTRODUCTION TO THE GLOBAL BURDEN OF DISEASE STUDY

The Global Burden of Disease Study (GBD) is the most comprehensive worldwide epidemiological study to date. It is a systematic effort to improve population health by quantifying the comparative magnitude of health loss from diseases, injuries and risks across countries, time, age and sex. The GBD identifies who is unhealthy, where they live and what their major health risk

factors are. These risk factors are defined as potentially modifiable behaviours or conditions that increase the likelihood of experiencing an adverse health event. Specifically, GBD closely examines three major classes of risk factors: behavioural, metabolic and environmental (Figure 1). All GBD risk factors are considered **modifiable risk factors** (MRFs), meaning they are amenable to interventions. WELL focuses on two out of the three types of MRFs – **behavioural** and **environmental** – which have the greatest potential to be addressed through improved building policies and practices, based on current scientific understanding. The conditions, illnesses and injuries that the MRFs contribute to are called **causes** and are categorised into three groups: 1) communicable, maternal, neonatal, and nutritional diseases; 2) non-communicable diseases; and 3) injuries. Figure 1 (below) gives a quick snapshot of the types of risk factors that contribute to most health loss in Australia, and what conditions these risk factors primarily contribute to. Table 1 (at the end of this brief) summarises the features in WELL that address the most burdensome behavioural and environmental risks.

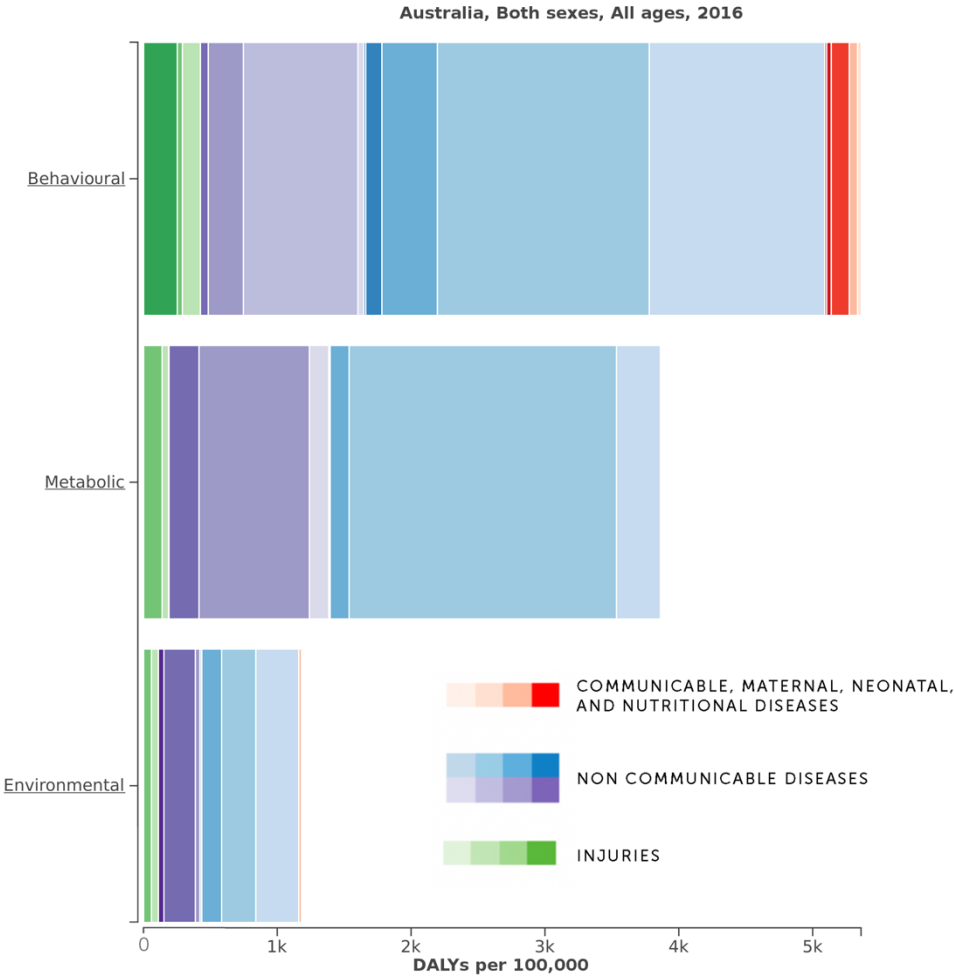


Figure 1. Distribution of health loss (DALYs per 100,000 individuals) due to modifiable risk factors by cause groups in Australia, both sexes, all ages, 2016. Source: Institute for Health Metrics and Evaluation (IHME). Used with permission. All rights reserved.



## HOW DOES THE GBD WORK?

Traditionally, estimating rates of disease and mortality in each country has been fraught with issues of over-counting, both from governments wanting to appear more effective in reducing rates of mortality, as well as charities claiming deaths as attributable to their particular cause, making it very hard to have accurate estimates.<sup>16</sup> The GBD is a single database that does not over-count health effects nor overestimate health risks, making it a tremendous open-access data resource. It examines multiple health metrics that are internationally comparable. These include [disability-adjusted life years \(DALYs\)](#), [years lived with disability \(YLDs\)](#), [years of life lost \(YLL\)](#), [life expectancy](#), [disease incidence](#) and [prevalence](#), [healthy life expectancy](#), and others.

## DISEASE BURDEN: TYPES OF BURDEN AND WELL

The key assumption underlying the GBD is that poor health conditions can be avoided or reduced through decreasing exposure to the MRFs that are associated with those health conditions. Death and disability due to MRFs are referred to herein as “[avoidable burden](#)” (e.g., DALYs due to smoking, an MRF). In addition, health conditions that stem from exposure to MRFs (e.g., lung cancer, the health condition (cause), due to smoking, the MRF) can also be “addressed” once a person already has a disease, disability or injury; these are referred to herein as “[addressable burden](#)”.

In this brief, the primary focus of intervention centres on avoidable burden. This is also the primary focus of WELL. However, avoidable burden also affects addressable burden because often the interventions targeting an MRF for a disease also address individuals who may already have that disease (e.g., smoking bans address both exposure to second-hand smoke and already existing respiratory conditions).

### Avoidable Burden

Avoidable burden is defined as the reduction in future disease burden if observed levels of exposure to a given risk factor are reduced to an alternative, or counterfactual, level or distribution, measured in DALYs. DALY is a metric that quantifies disease burden due to both premature death (YLL) and disability (YLD) and is calculated by adding the two together ( $DALY=YLD+YLL$ ) (Figure 2). Because the DALY metric captures *all* health loss – due to ill health, disability and early death, it is the metric that we have chosen to use for evaluating health loss and the prioritisation of WELL features that project teams may want to pursue to address health loss in Australia. Figure 3 shows how health loss due to all causes attributable to modifiable risk factors (measured in DALYs) is distributed globally.

# DALY

Disability Adjusted Life Year is a measure of overall disease burden, expressed as the cumulative number of years lost due to ill-health, disability or early death

$$= \text{YLD} \quad + \quad \text{YLL}$$

Years Lived with Disability      Years of Life Lost

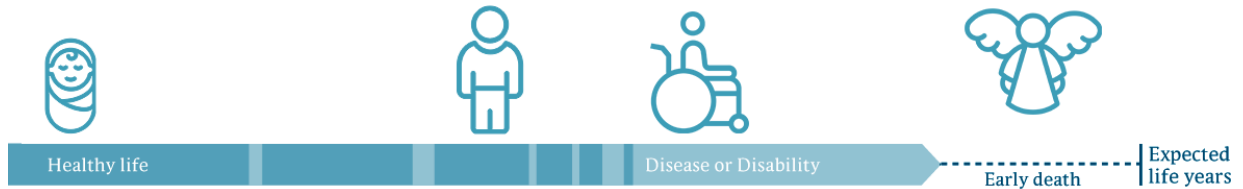


Figure 2. Visual representation of the DALY metric.

All behavioural and environmental GBD risk factors are potentially modifiable and therefore amenable to intervention (e.g., smoking as a risk factor for lung cancer). **Metabolic risk factors** are biological metrics which essentially act as indicators of early-stage disease and are typically only amenable to medical-based treatment and extreme lifestyle interventions. WELL does not represent clinical interventions and thus does not directly address any metabolic risk factors.

In this Country Brief, two groups of environmental risk factors – occupational risk factors and unsafe water, sanitation and handwashing – are only applicable in certain contexts – workplaces and residences, respectively. This is due to limitations in environments in which these risk factors have been studied and included in the GBD. Therefore, for occupational risk factors and unsafe water, sanitation and handwashing, the relevance of any component of WELL that addresses these risk factors is limited to the appropriate contexts (i.e., in occupational settings only, or in residential settings only).

## Addressable Burden

Addressable burden is referred to as “disability” that can be made more liveable or of higher quality through one or more solutions. It is quantified using YLDs and is referred to as “causes” in the GBD. Thus, it is essentially a measure of the quality of life of those already afflicted by a condition or several conditions. The more YLDs are present in a population, the more the population is afflicted with already existing health conditions.

While WELL does not rank its features based on addressable burden and does not explicitly aim to address addressable burden through its features, some fraction of addressable burden will still be addressed by choosing features that impact the most DALYs in a given country. This is because top MRFs for avoidable burden generally contribute to top causes of addressable burden. For example, in Australia, smoking is the number one modifiable risk factor; smoking also contributes significantly to **neoplasms** and **cardiovascular diseases**, which are the top two causes of disability in Australia.

**All causes attributable to All risk factors  
Both sexes, Age-standardised, 2016, DALYs per 100,000**

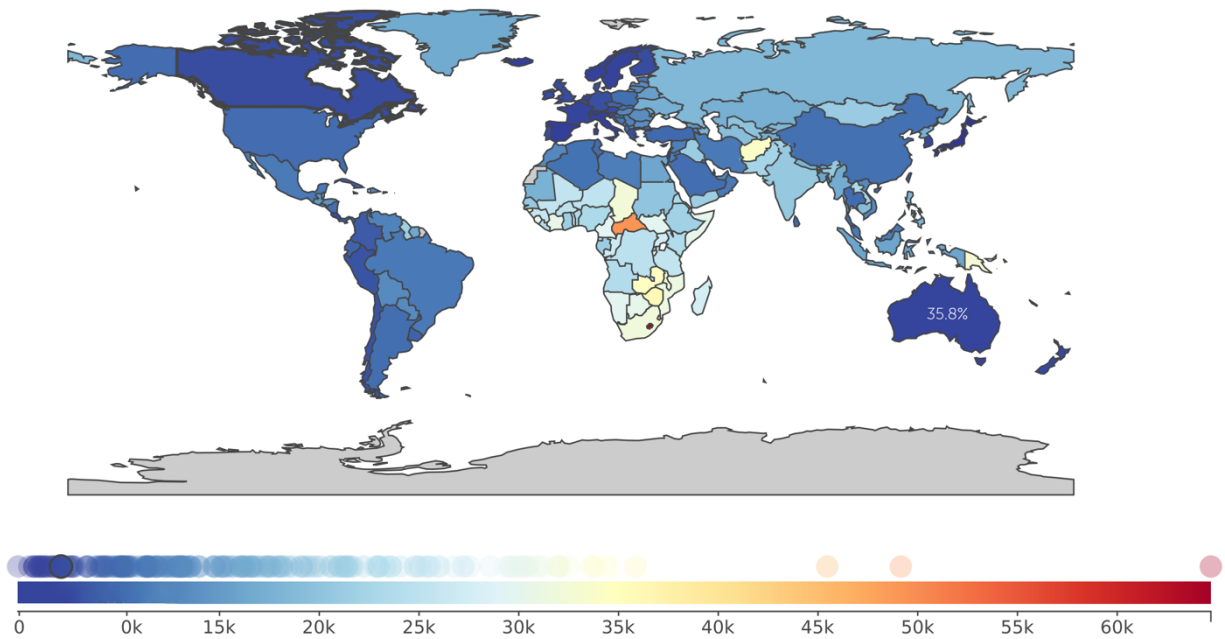


Figure 3. Distribution of health loss globally (DALYs per 100,000 individuals) due to all causes attributable to risk factors in both sexes, all ages, 2016. 35.8% indicates the percentage of total health burden attributed to modifiable risk factors. Source: Institute for Health Metrics and Evaluation (IHME). Used with permission. All rights reserved.

## THE GBD AND WELL

This Country Brief identifies MRFs of greatest concern in Australia based on available GBD data and links these MRFs to WELL features that have the potential to address those MRFs. Linkages are established between WELL features and GBD risk factors in all instances where implementing a specific WELL feature could theoretically have an impact on that risk factor<sup>1</sup>. The establishment of a linkage does not imply that the implementation of the WELL feature in question will definitively address or resolve morbidities or mortalities associated with the relevant MRF. The linkages do, however, point to instances in WELL where a feature may address an MRF in the GBD, and how much health loss is associated with each MRF. Based on this information, project teams may want to consider pursuing and prioritising some features over others if they want to

<sup>1</sup> A subset of all GBD modifiable risk factors and causes are used in WELL.



maximise the potential positive health impact of WELL certification on people in a building based on national-level data for the country.

GBD data can be used to identify the most important behavioural, metabolic and environmental risk factors in a country. WELL features can address behavioural and environmental risk factors through solutions focused on building design and policy and by providing information that can help encourage people to modify their behaviours. When implemented, these solutions may reduce the exposure to a risk factor for people in the building, potentially helping to prevent conditions associated with those risk factors from developing in the future. They can also assist in addressing existing health conditions to which those risk factors are known to contribute.

In linking MRFs to WELL features, an [ordinal ranking](#) of WELL features is presented. This order may serve as a recommendation for project teams on which features to prioritise based on those features' potential ability to address MRFs of greatest concern in Australia, as quantified by the number of associated DALYs.

## ESTABLISHING LINKAGES

At first, all environmental, behavioural and metabolic MRFs were considered when linkages were established between MRFs and WELL features. Metabolic risk factors were eventually excluded from consideration because these are typically only amenable to medical-based treatment and extreme lifestyle interventions, and because the current scientific evidence lacks longitudinal data to support the impact of [built environment](#) interventions on metabolic risk factors.<sup>17,18</sup> These MRFs are nevertheless still presented in the overall list of top health risks in a country.

The associations established between MRFs and WELL features are either direct or indirect. Direct associations are those where the implementation of a WELL feature is likely to have an impact without requiring any extra action taken by an individual, compared to that individual's baseline behaviour. Examples include all environmental risk factors that are addressed through features in Air, Water, Materials, Sound and Movement concepts (e.g., air and water filtration strategies to remove pollutants, sound limits to reduce exposure to noise). Indirect associations are those where the implementation of a WELL feature may have an impact on the MRF but only if extra action is taken by the individual, compared to that individual's baseline behaviour. Examples include all behavioural risk factors that are addressed through features in Nourishment, Movement, Community and Mind concepts (e.g., provision of fruits and vegetables, sit-stand desks or substance use support).

# COUNTRY SUMMARY

Figure 4 below shows the distribution of MRFs in Australia in 2016 (expressed in DALYs per 100,000 people, both sexes, all ages). The behavioural and environmental risk factors addressed by WELL are marked with dots; green dots indicate behavioural risk factors that can be addressed by WELL; grey dots indicate environmental risk factors that can be addressed by WELL. The unmarked risk factors are not currently directly addressed by WELL features.

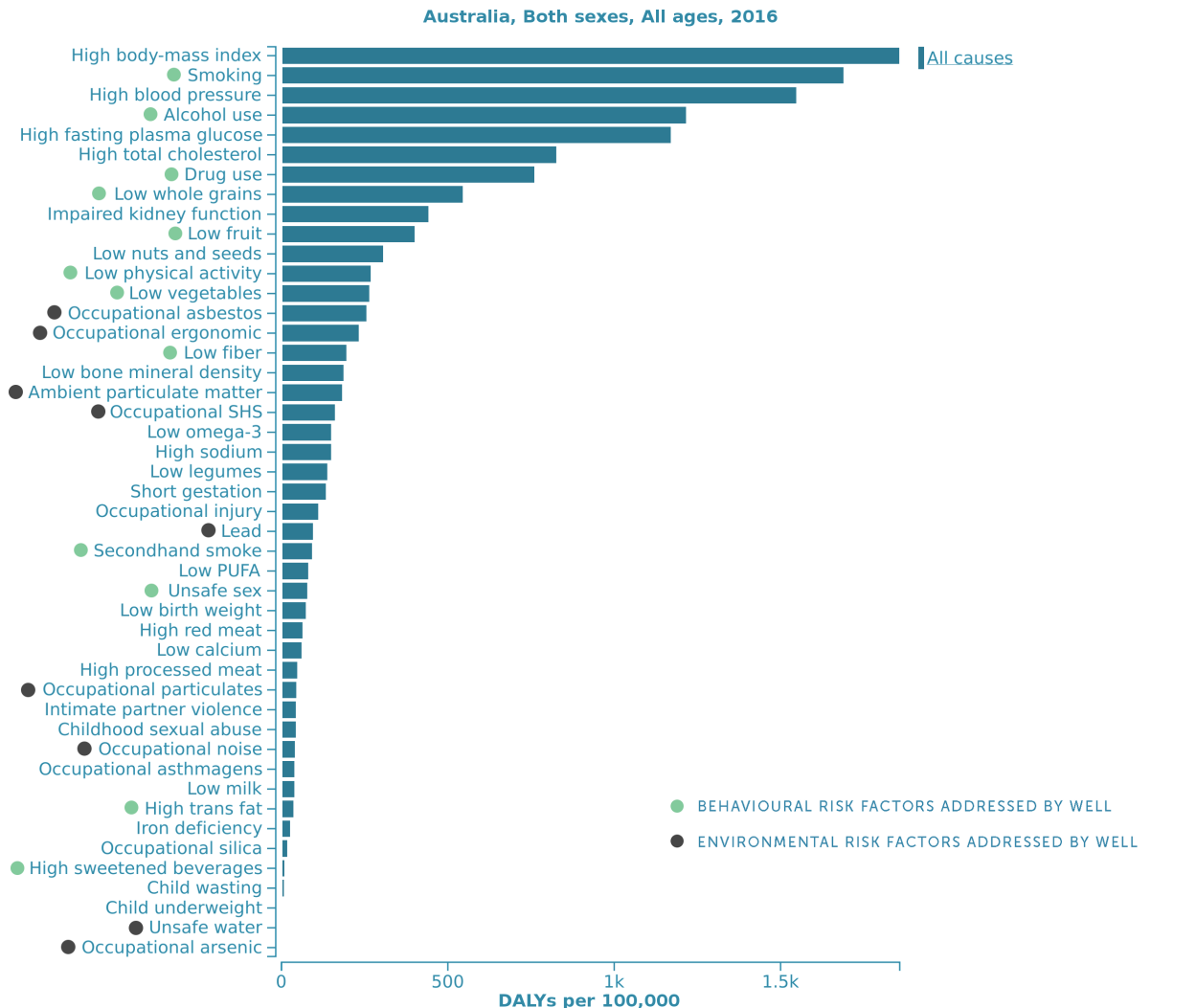


Figure 4. Top modifiable risk factors in Australia (both sexes, all ages, 2016). Source: Risk factor data from the Institute for Health Metrics and Evaluation (IHME). Used with permission. All rights reserved.

## TOP 10 MRFs IN AUSTRALIA ADDRESSED BY WELL

### 1) SMOKING

Smoking is a behavioural risk factor. The GBD calculates two measures to estimate smoking exposure: prevalence of daily smoking, and the [smoking impact ratio](#) (SIR). Prevalence of daily smoking is estimated by the five-year lagged proportion of the population that currently smokes any tobacco product on a daily basis. The SIR, an indicator of cumulative exposure to smoked tobacco products, uses mortality from lung cancer in excess of never-smokers as a biological marker for the accumulated hazards of smoking.<sup>19</sup> The theoretical minimum risk exposure level for smoking is all individuals are lifelong non-smokers.

In 2016, 1,690 DALYs per 100,000 individuals, or 7.51% of total DALYs were attributable to smoking in Australia due to all causes (both sexes, all ages).

WELL features that address smoking through policy such as smoking ban, and smoking cessation programs:

- A02 Smoke-Free Environment
- C05 Health Services and Benefits
- M13 Tobacco Prevention and Cessation

### 2) ALCOHOL USE

Alcohol use is a behavioural risk factor. The GBD exposure definition for alcohol use is average daily alcohol consumption of pure alcohol (measured in grams (g) per day) in current drinkers who had consumed alcohol during the past 12 months. The theoretical minimum risk exposure level for alcohol use is zero alcohol consumption.

In 2016, 1,217 DALYs per 100,000 individuals, or 5.41% of total DALYs were attributable to alcohol use in Australia due to all causes (both sexes, all ages).

WELL features that address alcohol use through health benefits, mental health services and employee assistance programs:

- C05 Health Services and Benefits
- M01 Mental Health Promotion
- M03 Mental Health Support
- M14 Substance Use Education and Services

### **3) DRUG USE**

Drug use is a behavioural risk factor. The GBD exposure definition for drug use is the proportion of the population dependent upon opioids, cannabis, cocaine or amphetamines; proportion of the population who have ever injected drugs. The theoretical minimum risk exposure level for drug use is no drug use.

In 2016, 762 DALYs per 100,000 individuals, or 3.39% of total DALYs were attributable to drug use in Australia due to all causes (both sexes, all ages).

WELL features that address drug use through mental health services and employee assistance programs:

- C05 Health Services and Benefits
- M01 Mental Health Promotion
- M03 Mental Health Support
- M14 Substance Use Education and Services
- M15 Opioid Emergency Response Plan

### **4) LOW WHOLE GRAINS**

A diet low in whole grains is a behavioural risk factor. The GBD defines whole grain intake as average daily consumption of whole grains (bran, germ, and endosperm in their natural proportion) from breakfast cereals, bread, rice, pasta, biscuits, muffins, tortillas, pancakes, and other sources. The theoretical minimum risk exposure level for a diet low in whole grains is the consumption of whole grains between 100 g and 150 g per day.

In 2016, 547 DALYs per 100,000 individuals, or 2.43% of total DALYs were attributable to a diet low in whole grains in Australia due to all causes (both sexes, all ages).

WELL feature that addresses a diet low in whole grains sets limits on refined ingredients:

- N03 Refined Ingredients

### **5) LOW FRUIT**

A diet low in fruit is a behavioural risk factor. The GBD defines fruit intake as the average daily consumption of fruits (fresh, frozen, cooked, canned or dried fruits, excluding fruit juices and salted or pickled fruits). The theoretical minimum risk exposure level for a diet low in fruit is the consumption of fruit between 200 g and 300 g per day.

In 2016, 403 DALYs per 100,000 individuals, or 1.79% of total DALYs were attributable to a diet low in fruits in Australia due to all causes (both sexes, all ages).

WELL features that address a diet low in fruit through healthy choice placement, providing access to local food and to gardening:

- N01 Fruits and Vegetables
- N12 Food Production
- N13 Local Food Environment

## 6) LOW PHYSICAL ACTIVITY

Low physical activity is a behavioural risk factor. The GBD exposure definition for physical activity is the average weekly physical activity at work, home, transport-related, and recreational measured by MET min (metabolic equivalent minutes) per week. The theoretical minimum risk exposure level for low physical activity is all adults experience 3000–4500 MET min per week.

In 2016, 271 DALYs per 100,000 individuals, or 1.20% of total DALYs, were attributable to low physical activity in Australia due to all causes (both sexes, all ages).

WELL features that address low physical activity through activity incentive programs, provision of active workstations, dedicated activity spaces, and other design elements:

- C16 Community Access and Engagement
- V03 Movement Network and Circulation
- V04 Active Commuter and Occupant Support
- V05 Site Planning and Selection
- V06 Physical Activity Opportunities
- V07 Active Furnishings
- V08 Physical Activity Spaces and Equipment
- V09 Exterior Active Design
- V11 Physical Activity Promotion
- V12 Self-Monitoring

## 7) LOW VEGETABLES

A diet low in vegetables is a behavioural risk factor. The GBD defines vegetable intake as an average daily consumption of vegetables (fresh, frozen, cooked, canned or dried vegetables, excluding legumes and salted or pickled vegetables, juices, nuts and seeds, and starchy vegetables such as potatoes or corn). The theoretical minimum risk exposure level for a diet low in vegetables is the consumption of vegetables between 290 g and 430 g per day.

In 2016, 266 DALYs per 100,000 individuals, or 1.18% of total DALYs were attributable to a diet low in vegetables in Australia due to all causes (both sexes, all ages).

WELL features that address a diet low in vegetables through healthy choice placement and providing access to local food and gardening:

- N01 Fruits and Vegetables
- N12 Food Production

## **8) OCCUPATIONAL ASBESTOS**

Occupational asbestos is an environmental risk factor. The GBD defines exposure to occupational asbestos as the proportion of the population with cumulative exposure to asbestos. The theoretical minimum risk exposure level for occupational asbestos is no occupational exposure to asbestos.

In 2016, 257 DALYs per 100,000 individuals, or 1.14% of total DALYs were attributed to occupational asbestos in Australia due to all causes (both sexes, all ages).

WELL features that address occupational asbestos through asbestos restrictions, construction hazards, hazardous material management and site assessment and cleanup:

- X01 Fundamental Material Precautions
- X02 Hazardous Material Abatement
- X05 In-Place Management
- X06 Site Remediation

## **9) OCCUPATIONAL ERGONOMIC FACTORS**

Occupational ergonomic factors are environmental risk factors. The GBD exposure definition for occupational ergonomic factors is the proportion of the population who are exposed to ergonomic risk factors for low back pain at work or through their occupation.

In 2016, 234 DALYs per 100,000 individuals, or 1.04% of total DALYs were attributed to occupational ergonomic factors in Australia due to all causes (both sexes, all ages).

WELL features that address occupational ergonomic factors through visual ergonomics support, desk and seat height flexibility, sit-stand desks and the provision of ergonomic education and consultation:

- V02 Visual and Physical Ergonomics
- V10 Enhanced Ergonomics

## **10) LOW FIBRE**

A diet low in fibre is a behavioural risk factor. The GBD defines a diet low in fibre as an average daily intake of fibre from all sources including fruits, vegetables, grains, legumes and



pulses. The theoretical minimum risk exposure level for a diet low in fibre is the consumption of fibre between 19 g and 28 g per day.

In 2016, 197 DALYs per 100,000 individuals, or 0.88% of total DALYs were attributed to a diet low in fibre in Australia due to all causes (both sexes, all ages).

WELL features that address a diet low in fibre through ensuring fruit and vegetable availability, promoting fruit and vegetable visibility, promoting whole grains, providing gardening space and ensuring food access:

- N01 Fruits and Vegetables
- N03 Refined Ingredients
- N12 Food Production
- N13 Local Food Production

Table 1. Ordinal ranking of features in Australia based on top modifiable risk factors (2016, both sexes, all ages) that can be addressed by WELL features.

Ordinal Feature Rank	Feature Name	Concept	Modifiable Risk Factor	Risk Factor Type
1	Health Services and Benefits	Community	Smoking	Behavioural
			Alcohol use	Behavioural
			Drug use	Behavioural
			Unsafe sex	Behavioural
2	Mental Health Promotion	Mind	Alcohol use	Behavioural
			Drug use	Behavioural
2	Substance Use Education and Services	Mind	Alcohol use	Behavioural
			Drug use	Behavioural
2	Mental Health Support	Mind	Alcohol use	Behavioural
			Drug use	Behavioural
5	Smoke-Free Environment	Air	Smoking	Behavioural
			Occupational exposure to secondhand smoke	Environmental
			Secondhand smoke	Behavioural
6	Tobacco Prevention and Cessation	Mind	Smoking	Behavioural
			Occupational exposure to secondhand smoke	Environmental
			Smokeless tobacco	Behavioural
7	Fruits and Vegetables	Nourishment	Diet low in fruits	Behavioural
			Diet low in vegetables	Behavioural
			Diet low in fibre	Behavioural
8	Food Production	Nourishment	Diet low in fruits	Behavioural

			Diet low in vegetables	Behavioural
			Diet low in fibre	Behavioural
8	Local Food Environment	Nourishment	Diet low in fruits	Behavioural
			Diet low in vegetables	Behavioural
			Diet low in fibre	Behavioural
10	Refined Ingredients	Nourishment	Diet high in sugar-sweetened beverages	Behavioural
			Diet low in whole grains	Behavioural
			Diet low in fibre	Behavioural
			Diet low in trans fatty acids	Behavioural
11	Opioid Emergency Response Plan	Mind	Drug use	Behavioural
12	In-Place Management	Materials	Occupational exposure to asbestos	Environmental
			Lead exposure	Environmental
12	Fundamental Material Precautions	Materials	Occupational exposure to asbestos	Environmental
			Lead exposure	Environmental
12	Site Remediation	Materials	Occupational exposure to asbestos	Environmental
			Lead exposure	Environmental
12	Hazardous Material Abatement	Materials	Occupational exposure to asbestos	Environmental
			Lead exposure	Environmental
16	Self-Monitoring	Movement	Low physical activity	Behavioural
16	Exterior Active Design	Movement	Low physical activity	Behavioural
16	Physical Activity Spaces and Equipment	Movement	Low physical activity	Behavioural
16	Community Access and Engagement	Community	Low physical activity	Behavioural
16	Physical Activity Promotion	Movement	Low physical activity	Behavioural
16	Movement Network and Circulation	Movement	Low physical activity	Behavioural
16	Active Commuter and Occupant Support	Movement	Low physical activity	Behavioural
16	Active Furnishings	Movement	Low physical activity	Behavioural
16	Site Planning and Selection	Movement	Low physical activity	Behavioural
16	Physical Activity Opportunities	Movement	Low physical activity	Behavioural
26	Enhanced Ergonomics	Movement	Occupational ergonomic factors	Environmental
26	Visual and Physical Ergonomics	Movement	Occupational ergonomic factors	Environmental
28	Fundamental Air Quality	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases and fumes	Environmental

			Occupational exposure to formaldehyde	Environmental
			Ambient ozone pollution	Environmental
			Residential radon	Environmental
29	Enhanced Air Quality	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases and fumes	Environmental
			Occupational exposure to formaldehyde	Environmental
			Ambient ozone pollution	Environmental
29	Ventilation Effectiveness	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases and fumes	Environmental
			Ambient ozone pollution	Environmental
31	Air Filtration	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases, and fumes	Environmental
31	Construction Pollution Management	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases and fumes	Environmental
31	Pollution Infiltration Management	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases and fumes	Environmental
31	Combustion Minimisation	Air	Ambient particulate matter pollution	Environmental
			Occupational particulate matter, gases and fumes	Environmental
35	Water Contaminants	Water	Lead exposure	Environmental
			Occupational exposure to arsenic	Environmental
			Unsafe water source	Environmental
			Occupational exposure to nickel	Environmental

			Occupational exposure to chromium	Environmental
			Occupational exposure to cadmium	Environmental
			Occupational exposure to benzene	Environmental
36	Outdoor Structures	Materials	Lead exposure	Environmental
36	Hazardous Material Reduction	Materials	Lead exposure	Environmental
38	Nutritional Transparency	Nourishment	Diet high in trans fatty acids	Behavioural
			Diet high in sugar-sweetened beverages	Behavioural
39	Sound Barriers	Sound	Occupational noise	Environmental
39	Maximum Noise Levels	Sound	Occupational noise	Environmental
41	Food Advertising	Nourishment	Diet high in sugar-sweetened beverages	Behavioural
42	New Parent Support	Community	Discontinued breastfeeding	Behavioural
			Non-exclusive breastfeeding	Behavioural
42	New Mother Support	Community	Non-exclusive breastfeeding	Behavioural
			Discontinued breastfeeding	Behavioural

## CAVEATS

The GBD presents national-level epidemiological data for each country in the world. It utilises a [disease modelling process](#) to provide the best-quality data available on what health concerns put people at risk and what health conditions they suffer and die from, so that key stakeholders in country governments, healthcare systems and the private sector can use it for making informed decisions on which health challenges to prioritise. The GBD produces highly precise country-level (and in some cases sub-national) estimates of disease burden, as well as the associated modifiable risk factors of that burden.

This precision can be lost, however, when applied to smaller populations within a country; the smaller the group, the less accurate the estimates will be, on average, particularly in larger countries that contain relatively heterogeneous subpopulations. The sub-population size represented within just one, even very large, building is extraordinarily small compared to the number of people in the country. It is possible, therefore, that using national-level disease data to

help set priorities for a project located in a specific building may not accurately reflect the disease burden of the people who live, work or study in that building.

With this in mind, it is important to note that project teams may have or may be able to acquire data that is more local or granular and would thus be more applicable to them than the country-level data used to make these recommendations. Such sources may include regional public health agencies, or even project-level data. In such instances, and if data sources are reliable, project teams may consider using such data in place of, or in conjunction with, the GBD estimates when making decisions on which WELL features to prioritise.

In addition, the GBD does not propose solutions to prevent or address health imperatives for each country. The GBD can help frame the problems, but we must rely on other sources of research to help judge which building design interventions might have a positive impact on health, wellbeing and disease outcomes. WELL brings to bear all available evidence to support the recommendations of its feature prioritisation, but the scientific understanding of the many relationships between buildings and health is still evolving.

Overall, the goals of WELL extend beyond the epidemiological model of health in the GBD and include the broader goal of promoting wellbeing.<sup>20</sup> Wellbeing includes constructs such as social connection, physical comfort, job satisfaction and other aspects of quality of life.<sup>21</sup> While these factors are not captured within an epidemiological framework and cannot be measured or quantified using the indicators in the GBD, they are important health metrics and critical components of public health surveillance that are measured through other robust tools (e.g., [psychometrically validated questionnaires](#)).<sup>21</sup> For example, some issues absent from the GBD, such as stress and sleep quality, have been linked to health outcomes,<sup>22,23</sup> and are thus included in WELL. WELL also seeks to address building parameters that impact physical comfort, satisfaction and job performance, such as lighting, thermal conditions, acoustic comfort and access to nature – all important factors that have been linked to health or comfort outcomes.<sup>24–27</sup> While these factors are not currently included in the GBD as modifiable risk factors, it is important to note that the GBD annually updates its database as well as the risk factors it assesses, so it is possible that some of these wellbeing factors would be incorporated at a future date.

Furthermore, WELL also recognises that it is not enough to provide opportunities for improved health without addressing barriers that often exist when trying to implement solutions that target behavioural change. Barriers to behavioural change can include a lack of access to opportunities for physical activity, cultural barriers, or even psychosocial factors.<sup>28,29</sup> Therefore WELL follows the practice of many public health agencies, employing a [social-ecological model](#) that recognises and addresses these barriers through its policy, design, and operations recommendations.

Given this background, project teams should recognise that the features identified in this Country Brief that may address top risk factors in their country as outlined in the GBD are only addressing a subset of factors influencing health and wellbeing. Project teams should also consider the specific concerns of the people who occupy the building and other applicable factors in their selection of features to pursue.

# GLOSSARY

**Addressable burden:** The quantity of “disability” that can be made more liveable or of higher quality through one or more interventions.

**Avoidable burden:** Reduction in future disease burden if observed current and future exposure levels are reduced to those specified by an alternative, or counterfactual, distribution.

**Behavioural risk factors:** Alcohol use, child stunting, child underweight, child wasting, childhood sexual abuse, diet high in processed meat, diet high in red meat, diet high in sodium, diet high in sugar-sweetened beverages, diet high in trans fatty acids, diet low in calcium, diet low in fibre, diet low in fruits, diet low in legumes, diet low in milk, diet low in nuts and seeds, diet low in polyunsaturated fatty acids, diet low in seafood omega-3 fatty acids, diet low in vegetables, diet low in whole grains, discontinued breastfeeding, drug use, intimate partner violence, iron deficiency, low birth weight for gestation, low physical activity, non-exclusive breastfeeding, secondhand smoke, short gestation for birth weight, smokeless tobacco, smoking, unsafe sex, vitamin A deficiency, zinc deficiency.

**Built environment:** The built environment refers to all physically constructed components of the environment where we live and work, such as homes, buildings, streets, open spaces, and infrastructure. The built environment has been shown to influence a person’s health, particularly their levels of physical activity.<sup>30</sup>

**Cause:** A single disease or injury or an aggregation of diseases and injuries that causes death or disability.

**Direct association:** Association where the implementation of a WELL feature is likely to have an impact on an MRF without requiring any extra action taken by an individual, compared to that individual’s baseline behaviour. Examples include all environmental risk factors that are addressed through features in Air, Water, Materials, Sound and Movement concepts (e.g., air and water filtration strategies to remove pollutants, sound limits to reduce exposure to noise).

**Disability:** Any condition that results in a state of sub-optimal health. Can be temporary and/or reversible (ear infection) or permanent and/or irreversible (deafness).

**Disability-adjusted life years (DALYs):** A measure of overall disease burden, expressed as the sum of years lost due to premature death (YLLs) and years lived with disability (YLDs). DALYs are also defined as years of healthy life lost.

**Disability weights:** Numerical representations of the severity of health loss associated with a health state. Derived from a worldwide, cross-cultural study to compare the relative severity of health problems, disability weights are numbers between 0 and 1 that are multiplied by the time spent living with a health loss to determine the years lived with disability associated with the cause of that loss.

**Disease modelling process:** In many parts of the world, health data is sparse and of variable quality. Mathematical modelling is used to take data collected from different sources, correct for inconsistencies, and fill in gaps when data is incomplete. A software tool known as DisMod-MR



(for Disease Modeling – Metaregression) is used to produce GBD estimates of the number of deaths from each cause by age, sex, country, and year.<sup>20</sup>

**Environmental risk factors:** Ambient ozone pollution, ambient particulate matter pollution, household air pollution from solid fuels, lead exposure, no access to handwashing facility, occupational asthmagens, occupational ergonomic factors, occupational exposure to arsenic, occupational exposure to asbestos, occupational exposure to benzene, occupational exposure to beryllium, occupational exposure to cadmium, occupational exposure to chromium, occupational exposure to diesel engine exhaust, occupational exposure to formaldehyde, occupational exposure to nickel, occupational exposure to polycyclic aromatic hydrocarbons, occupational exposure to secondhand smoke, occupational exposure to silica, occupational exposure to trichloroethylene, occupational injuries, occupational noise, occupational particulate matter, gases and fumes; residential radon, unsafe sanitation, unsafe water source.

**Epidemiological indicators of health:** Measurable characteristics of a population that can be used to describe population health. Examples include life expectancy, disability adjusted life years, infant and maternal mortality rate, incidence of asthma and obesity, among others.

**Food desert:** Neighbourhoods lacking access to affordable healthy food options, often due to a lack of supermarkets, large grocery stores, farmer’s markets, and other healthy food providers, particularly for those lacking access to a car.<sup>31</sup>

**Global Burden of Disease Study:** The Global Burden of Disease Study (GBD) is the most comprehensive worldwide epidemiological study to date. It is a systematic effort to improve population health by quantifying the comparative magnitude of health loss from diseases, injuries and risk factors across countries, time, age and sex. The GBD produces regular estimates of all-cause mortality, deaths by cause, years of life lost due to premature mortality (YLL), years lived with disability (YLD), and disability-adjusted life years (DALY). Comparison is the major guiding principle behind the GBD metrics, enabling comparisons between countries as well as between disparate health conditions.<sup>32</sup>

**Health:** A state of balance between physical, mental, and social states in the absence of illness. A component of wellbeing that is comprised of both mental or psychological (e.g., stress and anxiety levels, coping mechanisms) and physical or physiological (e.g., blood pressure, cholesterol levels) indicators. Measured through a physical (e.g., annual physical) and psychological (e.g., mental health assessment) work-up. Health changes over the long-term.<sup>33</sup>

**Health intervention:** Any activity done with the objective of improving human health, whether by preventing disease or injury or by reducing the severity or duration of an existing disease or injury.<sup>34</sup>

**Healthy life expectancy:** The number of years that a person at a given age can expect to live in good health, taking into account mortality and disability.

**Incidence:** The rate of new cases of a disease in a population over a given period of time (usually a year).

**Indirect association:** Association where the implementation of a WELL feature may have an impact on an MRF, but only if extra action is taken by the individual, compared to that individual’s

baseline behaviour. Examples include all behavioural risk factors that are addressed through features in Nourishment, Movement, Community and Mind concepts (e.g., provision of fruits and vegetables, sit-stand desks, or substance use support).

**Life expectancy:** Number of years a person is expected to live based on their present age. For GBD, the life expectancy for an age group (e.g., 50- to 54-year-olds), is determined from the first year in the age range.

**Metabolic Equivalent (MET):** A unit used to describe energy expenditure from performing a specific activity. MET is the ratio of the rate of energy expended during an activity to the rate of energy expended at rest. Rate of energy expenditure at rest is 1 MET. An activity of 5 METs would expend five times the energy used by the body at rest. Performing a 5 MET activity for 30 minutes would result in 150 MET-minutes of physical activity.<sup>35</sup>

**Metabolic risk factors:** High body mass index, high fasting plasma glucose, high systolic blood pressure, high total cholesterol, impaired kidney function, low bone mineral density.

**Modifiable risk factor:** A potentially modifiable behaviour or condition that increases the likelihood of experiencing an adverse health event. Three major classes of risk factors are examined in the GBD: behavioural, metabolic, and environmental. All GBD risk factors are potentially modifiable and therefore amenable to intervention, e.g., smoking as a risk factor for lung cancer.

**Neoplasms:** An abnormal tissue mass resulting from greater than normal cell division, or when cells do not die when they should. Neoplasms can be either benign (not cancer) or malignant (cancer), and are also called tumors.<sup>36</sup>

**Ordinal ranking:** Data that shows the rank, or order of items and not their quantity or value.

**Prevalence:** The total number of cases of a given disease in a specified population at a designated time. It is differentiated from incidence, which refers to the number of new cases in the population at a given time.

**Psychometrically validated questionnaires:** Questionnaires that have been tested through psychometric validation techniques to ensure that they measure what they are designed to measure.<sup>37</sup>

**Risk:** Potentially modifiable causes of disease and injury.

**Sick building syndrome:** A condition where people in a building suffer from symptoms of illness attributed to time spent in poor indoor environmental conditions.<sup>9</sup>

**Smoking Impact Ratio (SIR):** An indicator of cumulative exposure to smoked tobacco products; it uses mortality from lung cancer in excess of never-smokers as a biological marker for the accumulated hazards of smoking.<sup>19</sup>

**Socio-demographic index (SDI):** A summary measure that identifies where countries or other geographic areas sit on the spectrum of development. Expressed on a scale of 0 to 1, SDI is a composite average of the rankings of the incomes per capita, average educational attainment, and fertility rates of all areas in the GBD study.

**Socio-ecological model:** A model that argues that individual behaviour and health status is shaped by factors at multiple levels, including individual, social, institutional, community and policy factors.<sup>38</sup> It is widely adopted by public health agencies and funders to explain barriers to health promoting behaviours and health outcomes.<sup>39</sup>

**WELL Building Standard™:** A global building rating system, developed and managed by the International WELL Building Institute™, that is focused on positive human health outcomes.

**WELL Community Standard™:** A district scale rating system that sets a new global benchmark for healthy communities.

**WELL concepts:** There are 10 concepts in WELL v2: Air, Water, Nourishment, Light, Movement, Thermal Comfort, Sound, Materials, Mind, and Community. Each concept is comprised of an overview and a list of features with distinct health and wellbeing intents.

**WELL features:** Features address specific aspects of occupant health, comfort or knowledge. Features can either be preconditions (required for certification) or optimisations (additional points available depending on the level of certification pursued). Each feature is divided into parts, which are often tailored to a specific building type. Within each part are one or more requirements, which dictate specific parameters or metrics to be met. In order for a project to receive credit for a particular feature, all of its applicable components must be satisfied. Features can be performance-based standards that allow flexibility in how a project meets acceptable quantified thresholds, or prescriptive standards that require specific technologies, design strategies or protocols to be implemented.

**WELL v2™ pilot:** Released on May 31, 2018, the WELL v2 pilot is the second version of the WELL Building Standard. After a period of public comment and expert advisory feedback, which will inform any changes, it will move from pilot phase into status as a completed standard.

**Wellbeing:** A person's attitude or subjective perception towards their physical, mental and social conditions. Characterised through scales of life satisfaction, happiness and prosperity. Although health factors can contribute to a person's wellbeing, other factors (e.g., life circumstances) contribute as well. Measured through surveys. Wellbeing changes over the long-term.<sup>40</sup>

**Wellness:** The process through which an individual becomes aware of, and makes choices towards, a healthy life and a higher state of wellbeing. An active undertaking. Could be measured through surveys establishing an individual's knowledge of and actions taken towards healthy lifestyle choices. Alternatively, wellness could be measured indirectly through improvements on health and wellbeing measures.<sup>41</sup>

**Years lived with disability (YLDs):** Years of life lived in less than ideal health with any short-term or long-term health loss.

**Years of life Lost (YLL):** Years of life lost due to premature mortality compared with the maximum healthy life expectancy by age, group and sex.

*Source of GBD definitions and health statistics: Institute for Health Metrics and Evaluation (IHME). Used with permission. All rights reserved.*

## REFERENCES

1. Institute for Health Metrics and Evaluation (IHME), University of Washington. GBD Compare. 2018. <https://vizhub.healthdata.org/gbd-compare/>.
2. Saarloos D, Kim J-E, Timmermans H. The Built Environment and Health: Introducing Individual Space-Time Behavior. *Int J Environ Res Public Health*. 2009;6(6):1724-1743. doi:10.3390/ijerph6061724.
3. Organization WH, World Health Organization, Organization WH. *Global Status Report on Road Safety*. Geneva, Switzerland: World Health Organization; 2015. [http://www.who.int/violence\\_injury\\_prevention/road\\_safety\\_status/2015/en/](http://www.who.int/violence_injury_prevention/road_safety_status/2015/en/).
4. Laumbach RJ, Kipen HM. Respiratory health effects of air pollution: update on biomass smoke and traffic pollution. *J Allergy Clin Immunol*. 2012;129(1):3. doi:10.1016/j.jaci.2011.11.021.
5. Kelly FJ, Fussell JC. Air pollution and public health: emerging hazards and improved understanding of risk. *Environ Geochem Health*. 2015;37(4):631-649. doi:10.1007/s10653-015-9720-1.
6. Dubowitz T, Zenk SN, Ghosh-Dastidar B, et al. Healthy food access for urban food desert residents: examination of the food environment, food purchasing practices, diet, and body mass index. *Public Health Nutr*. 2015;18(12):2220-2230. doi:10.1017/S1368980014002742.
7. Loftness V, Hakkinen B, Adan O, Nevalainen A. Elements That Contribute to Healthy Building Design. *Environ Health Perspect*. 2007;115(6):965-970. doi:10.1289/ehp.8988.
8. Riley E, Harris P, Kent J, Sainsbury P, Lane A, Baum F. Including Health in Environmental Assessments of Major Transport Infrastructure Projects: A Documentary Analysis. *Int J Heal Policy Manag*. 2018;7(2):144-153. doi:10.15171/ijhpm.2017.55.
9. U.S. Environmental Protection Agency. Indoor Air Facts No. 4 Sick Building Syndrome. Indoor Air Quality (IAQ). <https://www.epa.gov/indoor-air-quality-iaq/indoor-air-facts-no-4-sick-building-syndrome>. Published 1991. Accessed May 23, 2018.
10. Dales R, Liu L, Wheeler AJ, Gilbert NL. Quality of indoor residential air and health. *Can Med Assoc J*. 2008;179(2):147-152. doi:10.1503/cmaj.070359.
11. Allen JG, MacNaughton P, Satish U, Santanam S, Vallarino J, Spengler JD. Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments. *Environ Health Perspect*. 2015;124(6). doi:10.1289/ehp.1510037.
12. Czeisler CA, Gooley JJ. Sleep and circadian rhythms in humans. *Cold Spring Harb Symp Quant Biol*. 2007;72:579-597. doi:10.1101/sqb.2007.72.064.
13. Hanninen O, Knol AB, Jantunen M, et al. Environmental burden of disease in Europe: assessing nine risk factors in six countries. *Env Heal Perspect*. 2014;122(5):439-446. doi:10.1289/ehp.1206154.
14. Belojević G, Öhrström E, Rylander R. Effects of noise on mental performance with regard

- to subjective noise sensitivity. *Int Arch Occup Environ Health*. 1992;64(4):293-301. doi:10.1007/BF00378288.
15. Klepeis NE, Nelson WC, Ott WR, et al. The National Human Activity Pattern Survey (NHAPS): A resource for assessing exposure to environmental pollutants. *J Expo Anal Environ Epidemiol*. 2001;11(3):231-252. doi:10.1038/sj.jea.7500165.
  16. Smith JN. *Epic Measures*. New York, NY: Harper Waves; 2015. <http://www.harpercollins.ca/9780062237507/epic-measures>.
  17. GBD 2015 Obesity Collaborators, Afshin A, Forouzanfar MH, et al. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. *N Engl J Med*. 2017. doi:10.1056/NEJMoa1614362.
  18. Bray GA, Heisel WE, Afshin A, et al. The Science of Obesity Management: An Endocrine Society Scientific Statement. *Endocr Rev*. 2018;39(2):79-132. doi:10.1210/er.2017-00253.
  19. Ezzati M, Lopez AD. Smoking and Oral Tobacco Use. In: *Comparative Quantification of Health Risks*. WHO Press; 2004. <http://www.who.int/publications/cra/chapters/volume1/0883-0958.pdf>.
  20. Flaxman AD, Vos T, Murray CJL. *An Integrative Metaregression Framework for Descriptive Epidemiology*. (Flaxman AD, Vos T, Murray CJL, eds.). Seattle, WA: The University of Washington Press; 2015.
  21. Centers for Disease Control and Prevention. Well-Being Concepts. Health-Related Quality of Life. <https://www.cdc.gov/hrqol/wellbeing.htm#one>. Published 2016. Accessed May 23, 2018.
  22. The National Academies of Sciences Engineering Medicine. *Sleep Disorders and Sleep Deprivation*. (Colten HR, Altevogt BM, eds.). Washington, D.C.: National Academies Press; 2006. doi:10.17226/11617.
  23. Schneiderman N, Ironson G, Siegel SD. STRESS AND HEALTH: Psychological, Behavioral, and Biological Determinants. *Annu Rev Clin Psychol*. 2005;1:607-628. doi:10.1146/annurev.clinpsy.1.102803.144141.
  24. Maller C, Townsend M, Pryor A, Brown P, St Leger L. Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promot Int*. 2006;21(1):45-54. <http://dx.doi.org/10.1093/heapro/dai032>.
  25. Stansfeld SA, Matheson MP. Noise pollution: non-auditory effects on health. *Br Med Bull*. 2003;68:243-257. <https://www.ncbi.nlm.nih.gov/pubmed/14757721>.
  26. LeGates TA, Fernandez DC, Hattar S. Light as a central modulator of circadian rhythms, sleep and affect. *Nat Rev Neurosci*. 2014;15(7):443-454. doi:10.1038/nrn3743.
  27. Rupp RF, Vasquez NG, Lamberts R. A review of human thermal comfort in the built environment. *Energy Build*. 2015;105:178-205.
  28. Olson JM. Psychological Barriers to Behavior Change: How to identify the barriers that inhibit change. *Can Fam Physician*. 1992;38:309-319. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2145450/>.
  29. Ralf S. Modeling Health Behavior Change: How to Predict and Modify the Adoption and

- Maintenance of Health Behaviors. *Appl Psychol*. 2008;57(1):1-29. doi:10.1111/j.1464-0597.2007.00325.x.
30. Centers for Disease Control and Prevention. Impact of the Built Environment on Health. 2011. <https://www.cdc.gov/nceh/publications/factsheets/impactofthebuiltenvironmentonhealth.pdf>.
  31. Canadian Institutes of Health Research. Food access is everyone's business. <http://www.cihr-irsc.gc.ca/e/50303.html>. Published 2017. Accessed April 1, 2018.
  32. Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease (GBD). <http://www.healthdata.org/gbd>. Accessed August 29, 2018.
  33. World Health Organization. Constitution of WHO: principles.
  34. Smith P, Morrow R, Ross D. Types of intervention and their development. In: Smith P, Morrow R, Ross D, eds. *Field Trials of Health Interventions: A Toolbox*. 3rd Edition. Oxford University Press; 2015. <https://www.ncbi.nlm.nih.gov/books/NBK305514/>.
  35. Services USD of H and H. 2008 Physical Activity Guidelines for Americans. In: Washington, DC: U.S. Department of Health and Human Services; 2008. <http://health.gov/paguidelines/guidelines/children.aspx>.
  36. National Cancer Institute. NCI Dictionary of Cancer Terms. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/neoplasm>. Accessed August 29, 2018.
  37. McHorney CA, Ware JEJ, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care*. 1993;31(3):247-263.
  38. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351-377.
  39. Robert Wood Johnson Foundation. Social Determinants of Health.
  40. Diener E. Subjective well-being. *Psychol Bull*. 1984;95(3):542-575.
  41. National Wellness Institute. About Wellness: Six Dimension of Wellness. <https://www.nationalwellness.org/page/AboutWellness?> Accessed May 21, 2018.