National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

General Fact Sheet

General default parameters for estimating consumer exposure - Updated version 2014

RIVM report 090013003/2014

J.D. te Biesebeek et al.

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Colophon

J.D. te Biesebeek, RIVM
M.M. Nijkamp, RIVM
B.G.H. Bokkers, RIVM
S.W.P. Wijnhoven, RIVM

Contact:
A.G. Schuur
VSP, RIVM
gerlienke.schuur@rivm.nl

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Factsheet Algemeen
Algemene standaard parameters voor de schatting van consumentenblootstelling- Herziene versie 2014

Om mogelijke risico's van chemische stoffen in consumentenproducten te kunnen beoordelen, is het nodig een goede schatting te maken over de blootstelling aan chemische stoffen tijdens gebruik van het product. Met behulp van het computerprogramma ConsExpo kan voor consumenten berekend worden in welke mate zij binnenshuis tijdens het gebruik van bijvoorbeeld verf, schoonmaakmiddelen of cosmetica aan een bepaalde chemische stof worden blootgesteld. In de Factsheet Algemeen staan 'standaardwaarden' die bruikbaar zijn om de blootstelling aan een stof te schatten. Door deze standaardwaarden te gebruiken, wordt de blootstellingsschatting op een transparante en gestandaardiseerde manier uitgevoerd. Op basis van nieuwe informatie en inzichten heeft het RIVM de Factsheet Algemeen herzien. Deze versie vervangt daarmee de Factsheet Algemeen uit 2006.

De Factsheet Algemeen bevat standaardwaarden over de ruimtes waarin het product wordt gebruikt (bijvoorbeeld vloeroppervlak van een huiskamer) en over de persoon die blootgesteld wordt (zoals lichaamsgewicht en het oppervlak van lichaamsdelen). Er is informatie verstrekt over de inhalatiesnelheid van volwassenen en kinderen bij een verschillende mate van inspanning. Verder bevat de factsheet gegevens over de mate waarin verschillende ruimten van woningen worden geventileerd. Nieuw in deze versie van de factsheet zijn data over tijdsbesteding. Het document licht ook toe waarop de waarden zijn gebaseerd en het geeft de betrouwbaarheid van de geboden gegevens weer.

Naast de Factsheet Algemeen bestaan er een aantal product-specifieke factsheets voor verf, cosmetica, speelgoed, ongediertebestrijdingsmiddelen, desinfecterende middelen, reinigingsmiddelen en doe-het-zelfproducten. Deze factsheets bevatten voor een bepaalde productcategorie informatie over onder andere de duur van de blootstelling en hoeveelheid gebruikt product.

Trefwoorden: blootstelling, consument, risico, stoffen, ventilatievoud, kamergrootte, lichaamsoppervlak, lichaamsgewicht, inhalatiesnelheid, modelering

Abstract

General Fact Sheet
General default parameters for estimating consumer exposure -
Updated version 2014

In order to assess the potential risks of chemical substances in consumer products, it is necessary to estimate the consumer exposure during product use. The computer tool ConsExpo is able to calculate indoor human exposure to chemical substances in products such as paint, cosmetics or cleaning agents. The General Fact Sheet describes default values useful for estimating the exposure to a chemical substance. By using these defaults, the exposure assessment is performed in a transparent and standardized way. Based on new available information and developments, RIVM updated the General Fact Sheet in the current report, which replaces the General Fact Sheet 2006.

The General Fact Sheet contains default values for the room in which the exposure takes place (for example room size) and for the person that is exposed, such as body weight and the surface areas of different parts of the body. In addition, it presents information on the ventilation in houses. Similarly, information is provided on inhalation rates for adults and children while at rest and during exercise. New in this version of the fact sheet are data on activity patterns. The General Fact Sheet explains the underlying data leading to the defaults and the quality of the default values.

Apart from the General Fact Sheet, there are various product-specific fact sheets, e.g. for paint, cosmetics, children toys, pest control products, do-it-yourself products, disinfection products and cleaning agents. These fact sheets contain information, e.g. on the exposure duration and amount of product used.

Keywords: consumer exposure, product safety, risk assessment, chemical substances, ventilation rate, room size, body surface area, body weight, inhalation rate, modelling.

Contents

List of abbreviations

a.m.	Arithmetic mean
BMI	Body Mass Index
BZK	Ministry of the Interior and Kingdom Relations
BW	Body weight
CBS	Central Bureau of Statistics
CHAD	Consolidated Human Activity Database
CV	Coefficient of variation
DIW	Deutsches Institut für Wirtschaftsforschung
ECHA	European Chemical Agency
GM	Geometric mean
HEEG	Human Exposure Expert Group
HETUS	Harmonized Europe Time Use Survey
KEMI	Swedish Chemical Agency
KWR	Qualitative Registration for Homes
MHS	Municipal Health Services
NEGh	Nordic Exposure Group for Health
NVWA	Dutch Food and Product Safety Authority
OECD	Organisation for Economic Co-operation and Development
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RIVM	National Institute for Public Health and the Environment
PPP	Plant Protection Products Regulation
s.d.	standard deviation
SOEP	Scientific Use File
TNsG	Technical Notes of Guidance
UNECE	United Nations Economic Commission for Europe
US-EPA	United States – Environmental Product Agency
VSP	Centre for Safety of Substances and Products
VROM	Ministry of Housing, Spatial Planning and the Environment
VWS	Ministry of Health, Welfare and Sport
WHO	World Health Organisation
Q factor	Quality Factor

Samenvatting

Het huidige rapport is een herziening van de Factsheet Algemeen uit 2006, een belangrijk document met standaardwaarden (defaults) voor het maken van een blootstellingschatting voor de consument. Deze defaults zijn gekoppeld aan een database behorende bij het computerprogramma ConsExpo, een softwaremodel met de mogelijkheid om consumentenblootstelling aan chemische stoffen in consumentenproducten te berekenen voor verschillende blootstellingsroutes. ConsExpo is in het begin van de jaren negentig door het RIVM ontwikkeld en wordt nog steeds gebruikt door diverse (inter)nationale organisaties en binnen verschillende wettelijke kaders. Productspecifieke defaults zijn beschreven in additionele factsheets die blootstellingscenario's beschrijven voor productcategorieën zoals reinigingsmiddelen, cosmetica, verfproducten, ongediertebestrijdingsmiddelen, speelgoed, desinfecterende middelen en doe-het-zelfproducten.

Defaults die beschreven worden in de Factsheet Algemeen omvatten parameters zoals lichaamsgewicht, lichaamsoppervlak, kamergrootte en ventilatievoud. De eerste versie van deze factsheet dateert uit 2000 (Bremmer & van Veen 2000). In 2006 is er een vertaalde en beperkt herziene versie gepubliceerd (Bremmer et al. 2006a). De defaults zorgen voor een geharmoniseerde en gestandaardiseerde wijze van blootstellingschattingen, leidend tot realistische worst-case blootstellingschattingen.

In de huidige versie van de Factsheet Algemeen zijn nieuwe data meegenomen en zijn defaults, waar nodig, aangepast. Beoordeeld is of de parameters nog relevant en toepasbaar waren. Zijn de onderliggende data voor de defaults nog up-to-date of zijn er nieuwe data beschikbaar waardoor de default aangepast moet worden? De data en de defaults zijn gebaseerd op de Nederlandse situatie. Bij afwezigheid van geschikte Nederlandse data is er gebruik gemaakt van informatie uit andere landen.

In deze versie van de factsheet is informatie over defaultwaarden weergegeven in guidance documenten voor wettelijke kaders (voornamelijk REACH, biocidenwetgeving) toegevoegd. Daarnaast zijn distributies beschreven die van belang zijn voor een probabilistische blootstellingschatting, welke niet in de vorige versie van de factsheet opgenomen waren.
De Factsheet Algemeen beschrijft relevante informatie voor een blootstellingschatting voor alle groepen van consumentenproducten. De onderliggende data die gebruikt zijn voor het verkrijgen van de defaults worden uitgelegd en de betrouwbaarheid van de defaults wordt verantwoord met informatie over de kwaliteit.

In de factsheet staat gedetailleerde informatie over:
- Het volume en de oppervlaktes van kamers in Nederlandse woningen; deze data zijn herzien maar de defaults zijn niet aangepast
- Ventilatievoud in verschillende kamers in de woningen; deze data zijn herzien maar de defaults zijn niet aangepast
- Gewicht van Nederlanders, zowel voor volwassenen als voor kinderen (op basis van geslacht); deze data zijn herzien en op basis hiervan zijn de defaults aangepast

- Lichaamsoppervlakte en oppervlaktes van verschillende lichaamsdelen voor volwassenen en kinderen (op basis van geslacht); deze data zijn herzien en op basis hiervan zijn de defaults aangepast.

De Factsheet Algemeen bevat uitgebreidere informatie over de inhalatiesnelheid van volwassenen en kinderen op basis van de mate van activiteit. Daarnaast is deze factsheet uitgebreid met gegevens over de tijdsbesteding van consumenten.

Summary

The aim of the current report is to update the General Fact Sheet, an important document with default values for the assessment of consumer exposure to chemicals. The default values described in the previous versions of the General Fact sheet are included in a database coupled to the software model ConsExpo, which is able to calculate consumer exposure to chemicals in consumer products via all different exposure routes. ConsExpo was developed by RIVM in the early nineties and is still used by various (inter)national bodies and within different legal frameworks. Product-specific default values are described in an additional set of fact sheets containing scenario descriptions and model choices for the following product categories: cleaning agents, cosmetics, paints products, pest control products, disinfectant products, do-it-yourself products and children's toys.

Default values described in the General Fact Sheet include parameters such as bodyweight, skin surface area, room volume and room ventilation. The first version was written in 2000 (Bremmer & van Veen 2000). A translation and a version with minor updates were published in 2006 (Bremmer et al. 2006a). The defaults enable an exposure assessment to be performed in a harmonized and standardized manner, providing realistic worst-case exposure estimates.

In the current version of the General Fact Sheet, new available data are taken into account and default values are adjusted when necessary. Where possible, the default parameters are based on the Dutch situation. However, in absence of suitable data, information from outside the Netherlands has also been considered.
Information on default values, as was included in guidance documents for the implementation of the REACH or Biocides Regulations, has been added. In addition, probabilistic exposure assessment requires distributions of parameter values instead of deterministic point values. These distributions were not reported in the General Fact Sheet 2006, but are provided in the current fact sheet for parameters where available.

The General Fact Sheet describes information relevant for the estimation of exposure to chemical substances for all groups of consumer products. It describes the background data leading to the defaults and justifies the reliability of these default values with information on the quality. Detailed information is given on:
- The volume and surface area of rooms in Dutch dwellings; data have been updated, but defaults have not been changed;
- The air-change rate in various rooms in dwellings; data have been updated, but defaults have not been changed;
- Body weights of Dutch inhabitants, both for adults and children; data have been updated and, based on this data, defaults have been moderated;
- The total body surface area and the surface of body parts of adults and children; data have been updated and, based on these data, defaults have been moderated.

New in this fact sheet is more information on the inhalation rates of adults and children at different levels of activity and information on the activity patterns of consumers.

The General Fact Sheet contributes considerably to a fast, transparent and standardized assessment of the exposure to chemicals from consumer products.

1 Introduction

1.1 Introductory remarks to the updated version 2014

ConsExpo was developed in the early nineties on the request of the Keuringsdienst van Waren (currently Dutch Food and Product Safety Authority (NVWA)) and the Ministry of Health, Welfare and Sport (VWS) as a software model for calculating human exposure to chemicals from consumer products. ConsExpo is unique in its ability to estimate consumer exposure to chemicals in consumer products via all exposure routes. The current official version is ConsExpo 4.1 (for the manual, see Delmaar et al. 2005). In addition to the current version, a beta-version of ConsExpo 5.0 is available at present. This beta-version facilitates the exposure assessment for different populations, to multiple products and in various exposure scenarios. By combining all exposure routes and pathways, an aggregate exposure estimate for a population can be calculated. In addition to enabling aggregate exposure assessments, version 5.0beta contains improved options for probabilistic exposure assessment.

The ConsExpo software contains a database that provides default values, which are described in a series of fact sheets. The fact sheets are documents containing exposure scenario descriptions and default values for various product categories such as cleaning products, cosmetics, paint products, pest control products, disinfectant products, do-it-yourself products and children's toys (Bremmer et al. 2006a; 2006b; 2006c; 2002; 2007; Ter Burg et al. 2007; Prud'homme de Lodder et al. 2006a; 2006b). In addition, there is a General Fact Sheet containing default values for parameters such as bodyweight, body skin surface area, room volume and ventilation rate. The first version was written in 2000 (Bremmer and Van Veen). A translation and a version with minor updates is from 2006 (Bremmer et al. 2006a). The defaults described in the fact sheets enable an exposure assessment in a harmonized and standardized manner, providing realistic worst-case estimates, and are fit for use in both current ConsExpo software programmes versions – 4.1 and 5.0beta.

In 2013, RIVM prepared a report describing the use of the current fact sheets and newly available information, and provided a prioritization for updating the fact sheets (Schuur et al. 2013). Consequently, at the request of the Dutch Food and Product Safety Authority, RIVM updated the General Fact Sheet from 2006 (Bremmer et al. 2006a).
Since the latest update of the General Fact Sheet, new data have become available which have been evaluated and included, if appropriate. In principle, default values are chosen for the Dutch situation. Where no information on the Dutch situation is available, however, information from other countries is used. Bearing in mind the use of ConsExpo in different countries around the world and different legislative frameworks, in this update special attention is given to information on other information sources outside the Netherlands and default values as included in guidance documents for the implementation of the REACH or Biocides Regulations. The default values are presented as deterministic values, but the statistical information is also provided, which can be used in distributions in probabilistic (aggregate) exposure assessments (see Chapter 2).

Table 1 gives a short summary of the changes in the current version of the General Fact Sheet, compared with General Fact Sheet 2006.

Table 1: Overview of new information and changed defaults compared with the General Fact Sheet 2006

Chapter	Changes	Defaults
Chapter 1 Introduction	Minor textual changes	-
Chapter 2 Default setting and quality of the defaults	Minor textual changes	-
Chapter 3 Room size and ventilation	Update of available data	Room size and ventilation rate **unchanged**
Chapter 4 Anthropometric data	New data and calculations for body weight and surface area Inhalation rates included	Body weight and surface area **changed**
Chapter 5 Activity patterns	New chapter	-

1.2 ConsExpo

RIVM developed ConsExpo, a software tool for Consumer Exposure assessment, to be able to assess the exposure to substances from consumer products and the intake of these substances by humans. ConsExpo is a set of coherent general models that can be used to calculate the exposure to substances from consumer products. Within this computer program, consumer exposure can be estimated by choosing the most suitable model and filling in the required parameters of the product, such as the amount used or concentration of the substance within a product. ConsExpo calculates the exposure to the substance involved. It is used for the consumer exposure assessment under REACH (EC1907/2006) and described in the REACH guidance (ECHA 2012). Furthermore, ConsExpo is also one of the models that is used to assess the consumer exposure to biocides (Guidance on regulation (EU) No528/2012 concerning the making available on the market and the use of biocidal products).

ConsExpo is constructed using data on the use of products contained in fact sheets that are then combined with mathematical models. The program is based on relatively simple exposure models. The starting point for these models is the route of exposure, i.e. the inhalatory, dermal or oral route. The most appropriate exposure scenario and model is chosen for each route. Parameters needed for the exposure scenario and the model are filled in the ConsExpo tool. It is possible that exposure occurs simultaneously via different routes. In addition to data about the exposure, contact data — such as the frequency of use and the duration of use — are needed for calculation of the exposure. Using the data mentioned above, ConsExpo calculates the exposure. Further details on the ConsExpo program are described in Delmaar et al. (2005).

ConsExpo can be used for a screening assessment (first tier, often used in regulatory frameworks) or for an advanced (higher tier) assessment. For different exposure situations, different models are provided for calculating external exposure. ConsExpo also integrates the exposure via the different routes, resulting in a systemic dose. Different dosing regimens/exposure situations can be calculated (acute, daily, chronic exposure). ConsExpo can also run calculations using distributed input parameters and perform sensitivity analyses.
The computer model is publicly available. Default data are available via the database, which is an integral part of ConsExpo. The software, the user manual and the various fact sheets (see section 1.3) can be downloaded via the website

of the National Institute for Public Health and the Environment in the Netherlands (RIVM; www.rivm.nl/consexpo).

1.3 Fact Sheets

The fact sheets are documents that present key information for the consistent and harmonized estimation and assessment of the exposure to substances from consumer products when using ConsExpo. In the fact sheets, information about exposure to chemical substances is bundled into certain product or exposure categories and default parameters are given. A limited number of main product categories with similar products have been defined. Examples of these categories are paint, cosmetics, toys and pest control products, which are chosen in such a way that products with similar exposures can be combined. The choice of main product categories and subcategories is based on the product classifications used under REACH by the United States Environmental Product Agency (US-EPA) and the Swedish Chemical Agency (KEMI), as described by the Organisation for Economic Co-operation and Development (OECD, 2012).

These fact sheets are useful for characterizing and standardizing the exposure estimation in combination with ConsExpo, as well as for any exposure estimation without the use of the computer program. A main product category consists of as few categories as possible, which together describe the entire main category. The composition and the use of the type of products within the category are examined for every product category. To estimate the exposure, default models with default parameter values are determined for every product category, which are available via a database. Using these data, standardized exposure calculations for consumers resulting from, for instance, the use of cosmetics can be performed.

The following fact sheets are available (Table 2):

Table 2: *Classification of consumer products into main product categories, for which corresponding fact sheets are available:*

Main categories consumer products
Paint
Cosmetics
Children's toys
Pest control products
Disinfectants
Cleaning products
Do-it-yourself products

Main product categories are further divided into smaller product categories (subcategories). For example, the main product category Cosmetics includes the following product subcategories: shampoo, make-up, lipstick, toothpaste and deodorant, amongst others. The composition and the use of the type of products within the main category are examined for every product subcategory. To estimate the exposure of substances, default models with default parameter values are determined for every product subcategory.

The fact sheets provide general background information on exposure models. Furthermore, they describe various exposure scenarios for the specific products and set defaults for relevant exposure parameters. In general, the following topics are dealt with in the fact sheets:

- background information about the main category that is relevant for exposure;
- delimitation of the main category and description of the underlying product categories within it;
- general description of product category, containing information on:
  - the way the products are used;
  - composition of the products;
  - remarks about the product;
  - potentially problematic substances;
  - default scenarios and models;
  - default parameter values for the scenarios and models;
  - considerations that have led to the defaults.

1.4 General Fact Sheet

The General Fact Sheet gives general information about the fact sheets and deals with overarching topics that are relevant for several other main product categories. This fact sheet further provides details of:

- the boundary conditions under which the defaults are estimated;
- the way in which the reliability of the data is shown;
- parameters such as the ventilation rate and room size; anthropometric parameters such as body weight and the surface of the human body, or parts thereof;
- and new in this update: inhalation rates and activity patterns.

Reading guide to the General Fact Sheet
This General Fact Sheet provides information useful for exposure assessment within all the main product categories.
Chapter 2 focuses on general information about an exposure scenario and the choice of default exposure parameters within the fact sheets. Particular attention is paid to the limiting conditions under which the defaults are estimated, the definition of reliability and the way in which the reliability of the data is presented. Chapter 3 concentrates on specific parameters within the General Fact Sheet, such as room size and the rate of ventilation in housing. Chapter 4 focuses on anthropometric parameters, such as human body weight, skin surface and inhalation rate. Finally, Chapter 5 provides information on the activity patterns of consumers.

1.5 Database

The default parameters are available via the ConsExpo database, which is an integral part of ConsExpo. When selecting a sample product, the database provides default scenarios and parameter values for the models. When using the database, the user should always consult the corresponding fact sheet in order to be aware of the limitations and the foundations of the selected parameter values. The defaults can serve as a starting point for exposure estimation and should be used in the absence of accurate scenario data only. Whenever more detailed or more up-to-date information for the product is available, these data should be used instead.

Note: It is important to keep in mind that, at the moment this fact sheet was published, the database of ConsExpo was not yet updated with the information of this General Fact Sheet. Check www.rivm.nl/consexpo for the actual status.

2 Default settings and quality of the defaults

2.1 Default settings

The basis for the calculation and/or estimation of the default parameter values is a realistic worst-case scenario that considers consumers who frequently use a certain product under relatively less favourable conditions. For example, when using a cosmetic product, basic selections for parameter values are relatively frequent use, the application of a relatively large amount in a small room with a low ventilation rate and a relatively long stay in that room.

The parameter values in the fact sheets are aimed at (Dutch) consumers. They are chosen in a way that a relatively high exposure is calculated, in the order of magnitude of a 99th percentile of the population exposure distribution — in other words, the high-end user is aimed for. To achieve this goal, the 75th or the 25th percentile is calculated (or estimated) for each parameter. The 75th percentile is normally used for proportional parameters, except in the case of reverse proportional parameters, for which the 25th percentile is used, e.g. for body weight. For a significant number of parameters, there are actually too few data to calculate the 75th or 25th percentile. In such cases, an estimate is made which corresponds to the 75th or 25th percentile.
Multiplication of two 75th percentile parameter values will result in a 93.75th percentile, whereas multiplication of three 75th percentile parameter values will result in a 98.5th percentile. Given the number of parameters and the relationship between the parameters, it is expected that in general the calculated values for exposure will result in an approximation of the 99th percentile. The result is a 'reasonable worst-case' estimate for consumers who use relatively large amounts of a product under less favourable circumstances (Figure 1).

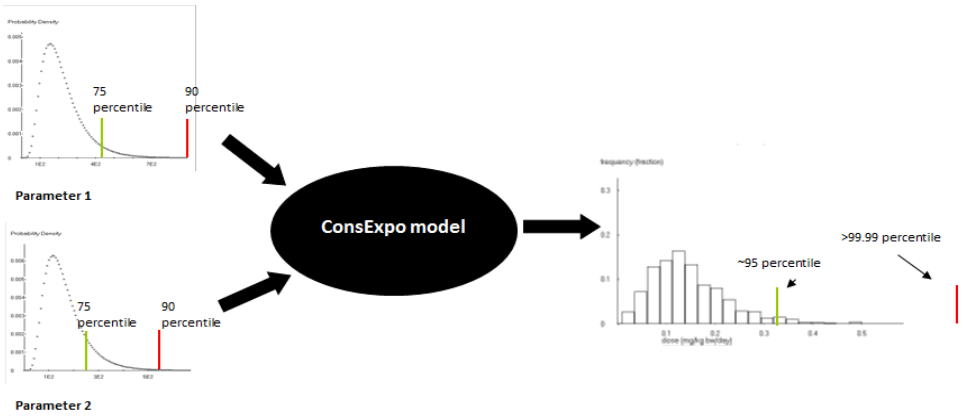

Figure 1: Illustration of the estimation of a 'reasonable worst-case' from variable data. Choosing a 75th percentile of the data for two uncorrelated parameters as input for a multiplicative model results in approximalety a 95th percentile of the exposure distribution. Choosing higher percentiles from each of the input data, such as a 90th percentile, quickly leads to an unrealistic overestimation. The effect of this 'cumulation' of worst case assumptions increases with the increasing number of input parameters.

In addition, probabilistic exposure assessment requires distributions of parameter values instead of deterministic point values. Such distributions were not reported in the General Fact Sheet 2006, but are, where available, provided in the current fact sheet for anthropometric parameters.

2.2 Quality of the default

Availability of data for exposure parameters is different for each parameter. For a number of parameters there is insufficient data to derive a reliable default. To indicate the reliability of a default value, a quality factor (Q) is introduced. The quality factor ranges from 1 (low quality) to 4 (high quality), see Table 3.

Low Q values (Q=1 or 2) indicate that the default value is based on insufficient data or a single data source and/or personal judgement only. If such a default is used in an exposure analysis, it should be used with care. If more representative data is supplied by applicants, producers or is available from other sources, it should be used instead of the default values.
High Q-factors (Q=3 or 4), on the other hand, indicate that the defaults are based on sufficient data. These defaults generally require less attention from the exposure assessor. It is possible that some parameters need to be adapted according to the exposure scenarios. For example, an exposure estimate might be carried out for a room of a particular size; the high quality default value for room size should be replaced by the actual value.

Table 3: Value of quality factor Q

Q	Value
4	Good quality relevant data, parameter value reliable
3	Number and quality of the data satisfactory, parameter value usable as default value
2	Parameter value based on single data source supplemented with personal judgement
1	Educated guess, no relevant data available, parameter value only based on personal judgement

3 Room size and ventilation

The room volume and ventilation within a room where consumer products are used have a major influence on the exposure to substances from consumer products. Both factors are important within exposure assessment for all the main product categories. Room size and surface area, as well as room ventilation defaults are set with the rationale used for the selection of the defaults. Basically, these defaults are applicable in general exposure scenarios. In the product-specific fact sheets, attention is given to aspects that are specific to the category concerned, which may lead to alterations of the defaults presented here.
Section 3.1 focuses on the room size and surface area in Dutch homes. In section 3.2, the ventilation of these rooms is discussed.

3.1 Room size and surface area

3.1.1 Data General Fact Sheet 2006

In the General Fact Sheet 2006, information on floor surface areas and room volumes in Dutch homes is presented (Table 4), based on data from the Qualitative Registration for Homes (KWR) collected at the request of the Ministry of Housing, Spatial Planning and the Environment (VROM 1997). This large-scale investigation describes the quality and quality development of Dutch housing stock. The figures shown in Table 4 were taken from a KWR data file dated 1989-1991 and reflect data on approximately 15,000 homes (Brouwer 1998). The figures thus describe surface areas and volumes for Dutch homes built up to 1991.

Table 4: *Floor surface area and volume of rooms in Dutch homes (General Fact Sheet 2006)*

	surface area (m^2)		volume (m^3)	
Space[a]	a.m.	s.d	a.m.	s.d.
living room	28	8.4	74	23
kitchen (incl. open kitchen)	8.5	3.6	22	9.6
bedroom 1	14	4.0	35	11.2
bedroom 2	11	3.0	28	8.3
bedroom 3	8.5	2.8	21	7.6
attic	23	15.8		

[a] Space; a.m. is arithmetic mean and s.d is standard deviation

Based on the available information, a 25^{th} percentile was calculated for the living areas listed. The KWR dataset specifies rooms as living rooms, bedrooms, kitchens and as unspecified. No data is provided for bathroom, toilet, shed and garage. For this reason, the General Fact Sheet 2006 combines the value of the unspecified room with own estimates of the surface area and volume of these rooms. A default value for an unspecified living area is given as a volume of 20 m^3, comparable with a small bedroom. This value can be used if no living area is specified in an exposure assessment or when a product is likely to be used everywhere in the home.

3.1.2 *New information*

The report "*Cijfers over Wonen en Bouwen 2013*" of the Ministry of the Interior and Kingdom Relations (BZK 2013) provides an insight into the quality and quality development of Dutch housing stock. Dutch homes are divided into four building periods; before 1945 (20%), 1945-1970 (26%), 1971-1990 (32%) and after 1990 (22%), with a total of 7.27 million homes in the Netherlands in 2012. Unfortunately, the Dutch government no longer gathers volume and surface area information routinely (Vroonhoven 2014). The BZK report (2013) shows that the data from KWR (VROM) are still applicable for 78% of Dutch homes in 2012. The surface areas and volumes of 22% (12% 1991-2000 and 10% 2001-2012) of new-built homes are not covered by the VROM data set.

New data gathered by Van Dijken & Boerstra (2011) are assumed to be more representative for single-family homes built in the period 2001-2012. Since 71% of the Dutch housing stock consists of single-family homes and new houses built during this period account for 10% of this group, this report covers 7.1% of the current Dutch housing stock. In this study, the performance of mechanical ventilation systems in newly built single-family homes (built in the period 2006-2008) was investigated. Ventilation rates and floor surface areas of individual rooms in 299 Dutch dwellings were measured. The surface area information, combined with a default ceiling height of 2.5 metres (Bouwbesluit 2003), enables the calculation of room volumes. Table 5 shows that recently built single-family homes have larger rooms compared with the rooms described in the data from VROM (VROM 1997), which contained all types of homes.
A report by Bader et al. (2009) presents ventilation rates for newly built homes (n=304) in the period 1994-2003. Assuming these homes are representative for the 1990s, this report covers 12% of the current housing stock. The average floor surface area (40 m^2) and volume (100 m^3) of the living rooms in these two above-mentioned reports are similar (Table 5).

Table 5: Floor surface area and room volumes of single-family Dutch homes (built in the period 2006-2008) calculated from raw data of Van Dijken & Boerstra (2011) and family homes (built in the period 1994-2003) from Bader et al. (2009).

Space	n	am		p25		p75		Reference
		area (m^2)	volume (m^3)	area (m^2	volume (m^3)	area (m^2)	volume (m^3)	
living room	125	41	100	32	80	50	126	Van Dijken & Boerstra (2011)
bedroom 1	115	18	44	14	35	20	50	
bedroom 2	116	14	34	10	25	15	38	
bedroom 3+	149	13	33	10	24	16	39	
Living room	304	42	104	33	80	48	118	Bader et al. (2009)
bedroom	304	16	38	13	33	17	48	

n: number of rooms; am: arithmetic mean; p25: 25th percentile; p75: 75th percentile

3.1.3 *Default values for room size*

The new data from Van Dijken & Boerstra (2011) and Bader (2009) cover 19.1% of the total housing stock, but both studies contain considerably fewer houses compared with the VROM dataset, which covers 78% of the housing stock (603 and 15,000 respectively). When recalculating average values and 25th percentiles including these new data, this only has a marginal influence on the current default values for room size. Furthermore, recalculation of the 25th percentile defaults will not lead to lower, e.g. more worst-case, values. Therefore, despite the availability of new data, room size defaults remain unchanged compared with the General Fact Sheet 2006 (Table 6). Since defaults are based on high-quality data, the Q factor is for all rooms adjusted to 4.

Note: If a specific house is relevant in an exposure assessment, e.g. the exposure situation is within newly built homes, the assessor might consider using values reported in Van Dijken & Boerstra (2011) or Bader (2009).

Table 6: Default values of Dutch rooms (similar to General Fact Sheet 2006) but with adapted Q-factor

Space	Surface Area [m^2] 25th	Volume [m^3] 25th	Q
living room	22	58	4
kitchen (incl. open kitchen)	6	15	4
bedroom 1	11	27	4
bedroom 2	9	22	4
bedroom 3	7	16	4
bathroom	4	10	4
toilet	1	2.5	4
shed	4	10	4
garage	15	34	4
unspecified room	8	20	4

3.1.4 *Legal frameworks*

Default values are described within different guidance documents linked to legal frameworks. In this paragraph, defaults of the most applied frameworks are given:

- *Biocidal Products Regulation:*

The default room volume is set at 50 m^3 (living room). For higher tier assessment, the Technical Notes of Guidance TNsG (2007) advises using the RIVM General Fact Sheet (2006).

- *REACH*

In the REACH guidance (Chapter R.15 Consumer exposure estimation, ECHA 2012), it is recommended that the data from the General Fact Sheet 2006 is used.

3.1.5 *Data from other countries*

The data and default parameters described above are based on the Dutch population. However, data from outside the Netherlands are available and presented in the Table below.

Table 7: Data from other countries

Reference	Countries	Data	n	Remarks
Expofacts (database checked March 2014)	Germany, Austria, Finland, Lithuania, Slovenia, Czech Republic, Denmark, Latvia, France, Hungary, Portugal, Poland, Romania, Switzerland	Floor surface area [m^2] presented for different rooms	See ExpoFacts	No information on room volume. Information is based on UNECE (United Nations Economic Commission for Europe) (2004) Housing and Building Statistics.
RefXP Version: June 2011-beta (database checked May 2014		Floor surface area [m^2] for living areas		SOEP 2001-2003 (Scientific Use File, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin 2004)
US-EPA (2011a) Building characteristics	United States of America	Total volume residence 492 m^3 [mean] 154 m^3 [10^{th} perc.] Total surface area residence 201.8 m^2 [mean] 63.2 m^2 [10^{th} perc.]	4,645	US-EPA 2010 analysis of U.S. Department of Energy (DOE) (2008). Detailed information available
NEGh Report (2011)	Nordic countries	Review of other sources	Review of other sources	NEgH report reviews room size information from other sources

3.2 Ventilation

The ventilation rate is the number of times per hour that the air in a space is exchanged [unit: h^{-1}]. As an exchange of air takes place between the different rooms in a home, part of the air that leaves a certain space can return again later. In this investigation, the ventilation rate is taken to be the *effective* flow of air from the space concerned.

The ventilation rate of a home or a room depends on a large number of factors, such as the age of the building, the insulation of the building, natural or mechanical ventilation, the climate indoors and weather conditions (wind speed and outside temperature) and personal behaviour. Table 8 shows measurements of ventilation rates in Dutch homes.

3.2.1 Data General Fact Sheet 2006

In the General Fact Sheet 2006, a literature search on ventilation rates is provided. The conclusion drawn from this search is that there are considerable differences between the ventilation rates noted in the different research projects

and that, within research projects, the difference between the highest and the lowest value of similar homes is very large (see Table 8).

The most important contributing factors for these large differences are:

The age of the building
Older houses have a higher ventilation rate than newer, better insulate and airtight buildings.

Natural or mechanical ventilation
When used and installed correctly, mechanically ventilated houses have a higher ventilation rate than the same type of houses with natural ventilation.

The climate
In northern countries (Scandinavia, Canada), the ventilation rate is lower, on average, than it is in the Netherlands.

Residents' behaviour
The ventilation rate is much higher if the windows and/or doors are open.

The season
Buildings are ventilated less in winter, so winter ventilation rates are low compared with summer ventilation rates.

The weather conditions
Within the framework of research on radon, RIVM has developed a computer model to calculate indoor radon concentrations (Janssen et al. 1998). For a standard Dutch home, ventilation rates have been calculated for thirty different weather conditions. Wind speed, in particular, has a large influence on the rate of ventilation. If wind speeds increase from calm to 8 $msec^{-1}$ (approximately wind force 5), then the ventilation rate of the entire house increases by approximately a factor of 4.

During the day / at night
For living rooms, and for complete homes, the ventilation rate during the day was approximately 10% higher, on average, than during the night
For bedrooms, a significantly larger rate of ventilation was found during the day than at night. On average, the rate of ventilation is approximately 50% higher during the day, probably because bedrooms are aired during the day.

Table 8: Measurement values for ventilation rates in Dutch homes (General Fact Sheet, 2006)

Space[a)]	Situation	Season	Measuring method	No. of measurements	Ventilation rate [h^{-1}] (range)	Reference
whole house	*natural ventilation*; renovated in 1984; windows, doors, additional ventilation openings closed	winter	inflation	6	0.6 (0.3-0.95)	Van der Wal et al. (1991)
	mechanical ventilation; renovated in 1983; windows, doors, additional ventilation openings closed	winter	inflation	4	1.2 (1.05-.35)	Van der Wal et al. (1991)
living room	*mechanical ventilation*; renovated in 1987	winter	inflation	4	1.85 (0.6-3.1)	Van der Wal et al. (1991)
	front room back room '60s flats '80s flats '60s family house '80s family house	Mar/Apr Mar/Apr Apr/May Apr/May Apr/May Apr/May	tracer tracer tracer tracer tracer tracer	1 1 6 3 4 4	0.98 0.86 1.15 0.77 1.08 0.81	Bloemen et al. (1992)
	during the day at night	Nov/Dec Nov/Dec	tracer tracer	36 36	0.42 (0.19-1.79) 0.39 (0.18-1.05)	Bloemen et al. (1993)
	with open kitchen, pre-1940 houses with open kitchen, post-1945 houses	Oct/Mar Oct/Mar	tracer tracer	6 26	1 (0.3-3) 2 (0.5-7)	Lebret et al. (1990)
	family houses built between 1985 and 1993	whole year	tracer	1253	0.9 (s.d. 0.7)	Stoop et al. (1998)
	family houses built between 1985 and 1993	whole year	tracer	827	0.97 0.85 (median) 0.56 (25th perc.) 1.17 (75th perc.)	Stoop (1999)
kitchen	*mechanical ventilation*; renovated in 1987	Winter	inflation	4	5 (1.7-8.3)	Van der Wal et al. (1991)
	pre-1940s houses post-1945 houses	Oct/Mar Oct/Mar	tracer tracer	69 72	6 (0.9-47) 4 (0.5-24)	Lebret et al. (1990)
bedroom	*mechanical ventilation*; renovated in 1987; closed windows	Winter	inflation	4	0.6 (0.3-0.9)	Van der Wal et al. (1991)

Space[a)]	Situation	Season	Measuring method	No. of measurements	Ventilation rate [h^{-1}] (range)	Reference
	mechanical ventilation; renovated in 1987; open windows	winter	inflation	4	2.75 (1.5-4.0)	Van der Wal et al. (1991)
	'60s flats '80s flats '60s family house '80s family house during the day	Mar/Apr Apr/May Apr/May Apr/May Apr/May	tracer tracer tracer tracer tracer	1 6 3 4 4	1.04 2.88 0.81 2.07 1.21	Bloemen et al. (1992)
	at night	Nov/Dec Nov Dec	tracer	36 36	3.7 (0.67-25) 2.36 (0.68-5.39)	Bloemen et al. (1993)
office	no extra ventilation, room door open outside window and room door opened window and door mostly closed	Jan/Feb Jan/Feb Jan/Feb	tracer tracer tracer	1 1 1	0.91 2.31 0.41	Bloemen et al. (1992)
	window and door closed, non-residential window and door opened, non-residential		tracer tracer	1 1	0.14 6.3	Van Veen et al. (1999)

a) Unless otherwise stated, constantly occupied domestic living spaces

Measurement methods
Ventilation rates are determined in a number of ways. It appears that the ventilation rate depends on the method used to determine it. Bloemen et al. (1993) have compared the tracer method with the inflation method. The ventilation rates determined by using the inflation method are clearly higher than, and did not correlate with those calculated by using the perfluorine tracer-gas method. Finnish researchers (referenced in Bloemen et al. 1993) have compared two different tracer techniques and, also here, differences were found between the methods. The most reliable determination method seems to be the frequently used perfluorine-tracer method.

3.2.2 New information

Nowadays, newly built houses are ventilated mechanically. In 2011, Van Dijken & Boerstra measured the mechanical low, middle and high ventilation capacities of individual rooms in single-family homes built between 2006 and 2008 (Table 9). The report concludes that the mechanical ventilation systems are insufficient to meet the Dutch Bouwbesluit criteria (Bouwbesluit 2003), even when the switch is turned to position 'high'. These criteria allow air exchange in living rooms from adjoining rooms of up to 50%, which was not taken into account in the measurements. So in living rooms, the ventilation rate presented by Van Dijken & Boerstra (2011) may be an underestimation, but the measured ventilations of bedrooms are accurate. Ventilation rates calculated by Bader et al. (Bader 2009) are comparable for living rooms but higher for bedrooms compared with results found by Van Dijken & Boerstra (see Table 9). These higher ventilation rates for bedrooms (average; 1.3/h) are calculated for residents sleeping with ventilation windows open during the night (personal communication Dekkers 2014).

Due to health complaints of residents living in mechanically ventilated houses, Jongeneel et al. (2011) investigated the relationship between health complaints and indoor environment and concluded that many homes are ventilated insufficiently, because residents turn down the ventilation (noise nuisance). Van Dijken en Boerstra confirmed this finding. In addition, owners of mechanical ventilation systems were advised to use the position 'middle', leading to insufficient ventilation rates (Van Dijken & Boerstra 2011). Also, the introduction of energy-saving measures reduces ventilation (Jongeneel et al. 2009).

Table 9: Measurement values for ventilation rates in Dutch homes- new data (Van Dijken & Boerstra 2011; Bader et al. 2009)

Space	Situation	Season	Measuring method	No of measurements	Ventilation rate (average)
	Single family home built between 2006 and 2008	*Dec-June*	*NEN1087*		*Van Dijken & Boerstra[a] (2011)*
Living room				131	0.29/h low 0.57/h middle 1.0/h high
Bedroom 1				131	0.29/h low 0.57/h middle 1.0/h high
Bedroom 2+				309	0.43/h low 0.71/h middle 1.0/h high
	Family home built between 1994 and 2003	*year*	*PFT and CATS*		*Bader et al. (2009)*
Living room				304	0.9/h
Bedroom				304	1.3/h

[a] Criteria 2.5 $m^3/h/m^2$: assuming room height of 2.5 m, ventilation equals 1 air exchange per hour; "high, middle or low": ventilation turned to maximum, middle or minimal capacity.

3.2.3 *Default values for ventilation*

To estimate the default values, Dutch data (Table 8) were used. Foreign observations (Table 12) were mostly used as supplementary background information, in support of the accuracy of the estimates. In the General Fact Sheet 2006, default values were deduced according to the criteria listed below.

Occupied domestic houses

The Dutch observations presented in Table 8 for domestic houses were all conducted in normally occupied accommodations.

Average winter ventilation rate equals the 25th percentile yearly ventilation rate

As stated in sub-section 2.1, the default values are defined as 75th or 25th percentile values. A 25th percentile is estimated for ventilation rates, because the consequence of relatively limited ventilation is that exposure will be relatively large. For the default value, a 25th percentile is estimated that should represent the yearly ventilation rate. By far most of the ventilation-rate measurements are carried out in winter. Considering the lower ventilation rates during winter, it is assumed that the average winter ventilation rate would approximate the 25th percentile of the yearly measured ventilation rate. The estimation of the defaults, therefore, is based on the average ventilation rates during winter.

Houses built during the '80s

With respect to the type of domestic accommodation, for the default values the choice made was for new, well-insulated housing built during the '80s.

During the day / at night
For the living room and for whole houses, the values of ventilation rates during the day and at night are so similar that one single value is given as the default value. For bedrooms, three default values are given — a general value, where there is relatively little ventilation, a value with an 'open window' and a value for bedrooms with only mechanical ventilation. The second can be read as the value during the day, when the bedroom is being aired, while the general value can be read as the default value for the nights.

Recalculation of averages and 25th percentiles will have a marginal influence on current ventilation rate defaults. Although the reports of Van Dijken & Boerstra (2011*)* and Bader et al. (2009) cover 19.1 % of the total housing stock, the number of houses in the dataset is limited compared with the VROM data set (see previous paragraph on room size).
The 25th percentile values stated in the General Fact Sheet 2006 are still considered to be worst-case assumptions. Therefore, ventilation defaults and Q factors are not adjusted (Table 10). In addition, due to noise nuisance during the night, residents turn down the ventilation system to position 'low'. This leads to a ventilation rate of 0.6 h^{-1} (Van Dijken & Boerstra 2011, Beuker 2014).

Table 10: Default values for room ventilation (25th percentile) (similar to General Fact Sheet 2006)

Room	Ventilation rate [h^{-1}]	Q
the whole house	0.6	3
living room	0.5	3
kitchen	2.5	3
bedroom	1	3
bedroom (window open)	2.5	3
bedroom (mechanical ventilation)	0.6	3
bathroom	2	3
toilet	2	3
shed	1.5	3
garage	1.5	3
default, if room is unspecified	0.6	3

Note: recently built single-family homes, especially in bedrooms (built in 2006-2008; van Dijken & Boerstra 2011) have low ventilation rates, due to improper use or improperly installed mechanical ventilation.

3.2.4 *Legal frameworks*

Within different guidance documents linked to legal frameworks, default values are described. In this section, default values of the most applied frameworks are given:

- Biocidal Products Regulation

The default value for room ventilation is set at zero. For higher tier assessment, the Technical Notes of Guidance (2007) advises using the RIVM General Fact Sheet (Bremmer et al. 2006).

- REACH

In the REACH guidance (Chapter R.15 Consumer exposure estimation, ECHA 2012), a conservative room ventilation default value of 0.2 h^{-1} is indicated.

3.2.5 *Data from other countries*

The data and default parameters described above are based on the Dutch population. However, data from outside the Netherlands are available and presented in the table below.

Table 11: Measurement values of ventilation rates of homes outside the Netherlands

Reference	Countries	Data	N	Remarks
Expofacts (database checked March 2014)	Finland	0.64/h [mean]	87	Apartments, all
		0.52/h [mean]	242	Dwellings, all
		0.45/h [mean]	155	Houses, all
		0.49/h [mean]	43	Houses, balanced ventilation
		0.46/h [mean]	56	Houses, mechanical exhaust
		0.41/h [mean]	56	Houses, natural ventilation
				Distribution of year 1998
	Norway	0/h to 2.65/h	175	Apartment
		0/h to 2.29/h	92	(Semi-) detached homes
		0/h to 1.64	77	Single family homes
US-EPA (2011a) Building characteristics	USA	0.45/h [mean]	4,645	Based on data from Koontz and Rector (1995)
		0.18/h [10th perc.]		
Özkaynak et al. (1996)	USA	1/h [median]	735	perfluorine-tracer method
		0.5/h [25th perc.]		
		1.7/h [75th perc.]		
		0.87/h [day]	175	
		0.78/h [night]	175	
Bloemen et al. (1992)	USA	0.39/h	9	tracer method; heating season
	Canada	0.25/h	7	tracer method; heating season; energy-saving homes
	USA	0.44/h	30	tracer method; heating season; energy-saving home
	Finland	0.5/h (0.1-1.2)	50	(al from Dietz et al. 1986) rate-of-decay tracer method
		0.8/h (0.2-1.9)	50	perfluorine tracer method (Ruotsalainen et al. 1989)
	Finland	0.45/h	162	perfluorine tracer method; winter;
		0.65/h	89	family houses flats (Rönnberg et al. 1990)
	Denmark	0.59/h (0.22-1.53)	67	post-1982 living accommodation; perfluorine-tracer method; winter
		0.33/h (0.20-0.50)	20	flats, mechanical ventilation
		0.55/h (0.22-1.16)	36	family homes, natural ventilation
				family homes, mechanical ventilation (Bergsoe 1991)

Stoop et al. (1998)	Denmark USA	0.37/h 025/h-0.4/h 1/h		New family homes (Andersen et al. 1997) Natural ventilation, closed ventilation openings Natural ventilation, open ventilation openings (Cavallo et al. 1996)
Spilak et al. (2014)	Denmark	0.15/h to 0.97/h	28	outdoor exchange rate; winter/summer
NEGh Report (2011)	Nordic countries	Review other sources	Review other sources	NEgH report reviews ventilation information from other sources

4 Anthropometric parameters

This chapter describes the anthropometrics of humans, which are needed in the calculation of exposure to chemical substances. Body surface area, body weight and the inhalation rate for men, women and children are discussed.

Children have a small ratio of body weight to surface area, compared to that of adults, which influences the exposure estimates. Exposure parameters such as body weight, body surface area and inhalation rates need to be available for specific sub-populations. The first step in an exposure assessment is to determine for which age group and personal activity the exposure estimation needs to be performed.

In this update of the General Fact Sheet, a different categorization of age groups is used from the one used in the previous version. This chapter presents new data on the body weight and surface area for adults and children categorised according to the early-life age groups presented by the WHO (WHO planning group members 2011) as recommended for tier 1 and 2 assessments.

Since 2006, multiple Dutch studies have become available, providing data on the body weight and height of individuals. These survey studies can be divided into two types; measured or self-reported body weight and height. Visscher et al. show that self-reporting males tend to overestimate their height and females tend to underestimate their body weight (Visscher et al. 2006). In section 4.1.2 new information from six studies is discussed; the studies are chosen because they meet the following criteria:

1) The studies are representative of either measured or self-reporting anthropometric data.
2) The studies describe anthropometric data from recent well known Dutch surveys, e.g. weight status of the Dutch population.
3) The studies are publicly available
4) The studies combine information for all WHO tier 1 and tier 2 age groups.

Schönbeck et al. assessed the prevalence of overweight and obesity among Dutch children and adolescents and concluded that the prevalence in children in 2009 was substantially higher than it was in 1980 and 1997. They suggested that the trend towards an increase in overweight in the Netherlands is starting to turn around (Schönbeck et al. 2011). De Wilde et al. reported a decrease in obesity among Dutch, Moroccan, Surinamese and South Asian children, while a stabilising trend in the prevalence of overweight and obesity in Turkish children since 2007 may indicate a levelling off (De Wilde et al. 2013). Blokstra et al. reported the increase in abdominal obesity, especially in women aged 30 to 39 years, as the largest difference compared with 15 years ago (Blokstra et al. 2011).
All in all, an update of the anthropomorphic parameter values seems reasonable because the new anthropomorphic data indicates that the population distribution of body weight, height and surface area has changed in recent years. In addition, probabilistic exposure assessment requires distributions of parameter values instead of deterministic point values. Such distributions have not been reported before, but will be provided in the current updated fact sheet. Below, in section 4.1.2., the statistics for body weight, body surface area and distributions

for adults and children are addressed briefly. For more detailed information, see Annex I.

Note: The parameters of body weight and body surface area are strongly correlated (see Annex I). Choosing a 25th percentile for body weight and a 75th percentile for body surface area would be too worst-case. Therefore, in compliance with the HEEG opinion (2013), it is suggested that percentile defaults for body weight and body surface area should be paired, thus 25th percentiles for both parameters.

4.1 Body weight

4.1.1 Data from General Fact Sheet 2006

The General Fact Sheet 2006 provides default body weights for men, women and children, based on data from the CBS (1997, 1998), Smit et al. (1994), Visscher et al. (1999), Steenbekkers et al. (1993), Verweij et al. (1994) and Fredriks et al. (2000). These studies used self-reporting measurements. Data from the CBS were used as statistical support for the calculation of the default values. The default values of the General Fact Sheet 2006 are reported in Annex II.

4.1.2 New information

Since 2006, multiple Dutch studies have become available that contain data on the body weight and height of individuals. These survey studies can be divided into two types; measured or self-reported body weight and height. Below, new information from six studies is discussed.

- The Dutch Central Bureau of Statistics (CBS) continuously updates body weight and height (self-reported) on Statline. Statline presents data for the period 1981-2012, but does not report height for age group 0-20 years. Body weights are grouped in age classes, the CBS can provide more detailed information on request (CBS 2014a; Bruggink 2014; not requested).
- Van Rossum et al. reported the self-reported body weights and heights of 3,819 participants in the Dutch National Food Consumption Survey 2007-2010. The surveyed population of children and adults aged 7 to 69 years consisted of people living in the Netherlands, and did not include pregnant and lactating women. Respondents were drawn from representative consumer panels of the Market Research GfK Panel Services (Van Rossum et al. 2011).
- During the Dutch National Food Consumption Survey - Young Children 2005/2006, body weights and heights were measured for children (Ocké et al. 2008). The surveyed population consisted of 1,276 boys and girls, ages 2 to 6 years, living in the Netherlands. Respondents were drawn from representative consumer panels of the Market Research Agency GfK. For each individual, the dataset contains information on date of birth, sex, body weight and height.
- Blokstra et al. measured body weight and height in the 2009-2010 period in the project "*Nederland de Maat Genomen*". In total, 4,500 individuals participated (ages 18-70 years), who were randomly drawn from 15 town registers of birth, spread across the Netherlands. The individuals from the age group 18-29 years were excluded by Blokstra et al. from the analysis because of the low survey response in this age group. Although Blokstra et al. discarded the age group 18 to 29 years, the anthropometric data is

considered relevant data for the purpose of this General Fact Sheet (Blokstra et al. 2011).
- Schönbeck et al. presented new data from the Fifth Dutch Growth Study, which was carried out in 2009. The Fifth Dutch Growth Study was a cross-sectional study in which data was collected on the growth of children aged 1–21 years (12,005 boys and girls) in the Netherlands. The measurements (body weights and height) took place between May 2008 and October 2009. The sample was stratified by region (regions of Municipal Health Services (MHS)), sex and age according to national distributions. The Fifth Dutch Growth Study dataset is considered to be an excellent representative dataset for the current Dutch subpopulation aged 1-21 years. However, only BMI (Body Mass Index) and the descriptive statistics for height are available (Schönbeck et al. 2013).
- The Department of Youth Health Care of the Municipal Community Health Services The Hague provided the individual body weight and height of children (0-16 years) born in The Hague, measured in years 2006 to 2011 (personal communication De Wilde, March 2014). The dataset, hereinafter called De Wilde (2014), consisted of 209,408 measurements.

Choice of dataset
Data from De Wilde (2014) for ages 0-16 years and Blokstra et al. (2011) for ages 18-70 years are reported in sufficient detail to describe the current body weights of the Dutch population. The dataset for the children from The Hague (De Wilde 2014) is conveniently large; however, it has some drawbacks. Children were measured on multiple occasions within a year or during the period of recording. Consequently, multiple records of the same individuals are included in the dataset. Moreover, the data are not distributed evenly across the age groups. Additionally, in some age groups no data have been collected at all. For example, no data were included for children aged 7, 8, 11, 12 and 17, and only limited data were included for 16 year-olds. The final drawback of the data from De Wilde (2014) is the fact that the distribution of individuals over various ethnic groups is not representative of the entire Dutch population.
The data on adults (ages 18-71; Blokstra et al. 2013) probably have the same drawbacks, i.e. they do not represent the actual Dutch population distribution in terms of age, sex and ethnicity.

To circumvent the unrepresentative distributions of the measurements (De Wilde 2014 and Blokstra et al. 2013) over age, sex and ethnicity, weighted body weights, heights and surface areas are derived. New data is modelled based on a description of the realistic composition of the Dutch population obtained from the CBS (Statistics Netherlands, 2014b; see Annex I for more detailed information on the method used and the calculations). From this point, new data are modelled body weights and body surface areas.

Summary statistics on body weight and body surface area are derived for several age groups as recommended by WHO for tier 1 and tier 2 assessments (WHO 2011). For body surface area, see section 4.2. The population is divided into twelve groups: neonatal (0 to >1 month), infant (1 to 12 months, divided into three age groups), toddlers (1-2 years), early childhood (2 to 6 years, divided into three age groups), middle childhood (6-11 years), early adolescence (11-16 years), late adolescence (16 to 18 years) and adults (>18 years). In contrast to the WHO, persons from 18 to 21 years are classified as adults in the current report. It should be noted that WHO recommends using ranges of ages, which is convenient when dealing with raw data. In that case, data of e.g.

children of exactly 2 years old will be scarce and pooling data from $2\frac{0}{365}$ year to $2\frac{364}{365}$ year can provide a sufficient sample size. In our approach (see Annex I) simulating fractions of ages is possible but unnecessary, because sufficient individuals of a particular age, e.g. of exactly 2 years old, can be simulated.

Summary statistics on the data are derived for adults. Age group and sex-specific results for adults are reported in Table 13 and Table 22 for body weight and body surface area, respectively. Summary statistics for body height can be found in Annex I. Summary statistics for children age groups and sex-specific results are reported in Tables 15 and 16 and Tables 26 and 27 for body weight and total body surface area, respectively. Height is not reported here, because height is not used as an input parameter in ConsExpo. Reported 5th, 25th, 50th, 75th and 95th percentiles, all parameters are derived from the raw data (see Annex I) without assuming a distribution. When visual inspection of the raw data (not shown) showed that the data are log-normal distributed, the geometric mean (GM) and coefficient of variation (CV) are reported to characterize these distributions. GM is the back-transformed mean and CV is defined in Annex I. For most age groups of children, GMs and CVs are not reported because visual inspection of the raw data (not shown) showed multimodal distributions.

Table 13 shows the summary statistics of the body weights of men and women ages 18 to 70. The population distribution of the body weights is log-normal distributed with the reported GM and CV. The GM obtained corresponds well with the arithmetic means (AM) reported in other recent studies (Table 12).

Table 12: Body weight (kg) of Dutch adults obtained from recent studies

	Age (years)	Arithmetic mean body weight (kg)	Reference
Men	>20 19-69 18-70	83.8 85.3 86.2[a]	CBS (2014a) Van Rossum et al. (2011) Blokstra et al. (2011)
Women	>20 19-69 18-70	70.1 74.3 71.2[a]	CBS (2014a) Van Rossum et al. (2011) Blokstra et al. (2011)
Adults	>20	77	CBS (2014a)

[a] arithmetic mean not reported by Blokstra et al. 2013, but calculated additionally for this report

Table 13: Modelled body weight (kg) of Dutch adults (age 18-70) (see Annex I)

	Men	Women	Adults
GM[a]	84.9	70.6	77.4
CV[b]	0.14	0.14	0.17
5th percentile	67.0	55.8	58.5
25th percentile	77.2	64.1	68.8
50th percentile	84.9	70.6	77.4
75th percentile	93.5	77.7	87.1
95th percentile	107.3	89.2	102.3

[a] Geometrical Mean

[b] CV: Coefficient of Variation

In Table 14, data on the body weights of Dutch children from a recent study are provided (Ocké et al. 2008). Table 15 and Table 16 show the summary statistics on the body weight of boys and girls, respectively. The age distribution of the body weights is not distributed log-normally, but distributed multimodally. Therefore, no GM and CV are calculated.

Table 14: Body weight (kg) of Dutch children obtained from a recent study (Ocké et al. 2008)

	Age (years)	Arithmetic mean body weight (kg)
Boys	2-3	15.7
	4-6	21.3
Girls	2-3	15.1
	4-6	21.1
boys + girls	2-3	15.2[a]
	4-6	21.2[a]

[a] calculated average of arithmetic means for boys and girls not reported Ocké et al. (2008)

Table 15: Modelled body weight (kg) of Dutch boys of different ages (see Annex I for the calculations)

Age		Percentiles						
Months	Years	5th	25th	50th	75th	95th	GM	CV
0-1		1.6	2.1	3.1	4.5	5.3		
1-3		3.9	4.7	5.4	6.2	7.3		
3-6		5.4	6.4	7.1	8.0	9.3		
6-12		7.0	8.3	9.2	10.3	11.9		
	1-2	8.6	10.1	11.5	13.2	15.5		
	2-3	10.9	12.7	14.1	15.7	18.2		
	3-6	13.3	15.9	18.2	20.8	24.8		
	2-6	11.8	14.5	17.2	20.1	24.3		
	6-11	19.7	24.4	29.7	36.1	44.8		
	11-16	36.8	45.1	52.8	61.2	73.2		
	16-18	54.1	62.2	68.4	75.4	86.6	68.4	1.15

[a] Geometrical Mean

[b] CV: Coefficient of Variation

Table 16: Modelled body weight (kg) of Dutch girls of different ages (see Annex I for the calculations)

Age		Percentiles						
Months	Years	5th	25th	50th	75th	95th	GM[a]	CV[b]
0-1		2.1	2.6	3.3	4.2	5.0		
1-3		3.6	4.3	5.0	5.7	6.7		
3-6		5.0	5.8	6.5	7.3	8.6		
6-12		6.5	7.6	8.5	9.6	11.2		
	1-2	8.0	9.4	10.9	12.6	14.9		
	2-3	10.4	12.1	13.6	15.2	17.7		
	3-6	12.9	15.5	17.8	20.5	24.5		
	2-6	11.3	14.0	16.8	19.8	24.0		
	6-11	19.3	24.2	29.6	36.1	44.9		
	11-16	36.5	44.4	51.2	58.4	69.2		
	16-18	49.1	56.4	62.1	68.3	78.4	62.1	1.15

[a] Geometrical Mean

[b] CV: Coefficient of Variation

4.1.3 *Default values for body weight of adults and children*

As explained in section 2.1, the default values for body weight are selected as worst-case default values; i.e. the 25th percentile is set as the new deterministic default (Table 17 and 18 for adults and children, respectively). Default values for children are based on the average of the 25th percentiles of boys and girls. Since default values are based on good quality data, the defaults are assigned a Q-factor of 4.

Table 17: Default values for body weight of adults

	Men	Women	Adults	Q-factor
Body weight (kg)				
Deterministic[a]	77.2	64.1	68.8	4
Probabilistic[b]				
GM	84.9	70.6	77.4	4
CV	0.14	0.14	0.17	

[a] Deterministic default is 25th percentile

[b] Body weight distribution for probabilistic calculations (GM: Geometrical Mean and CV: [c] CV: Coefficient of Variation)

Table 18: Default values for body weight of children

Age		Body weight	
Months	years	Default (kg)	Q-factor
0-1		2.4	4
1-3		4.5	4
3-6		6.1	4
6-12		8.0	4
	1-2	9.8	4
	2-3	12.4	4
	3-6	15.7	4
	2-6	14.3	4
	6-11	24.3	4
	11-16	44.8	4
	16-18	59.3	4

4.1.4 *Legal frameworks*

Within different guidance documents linked to legal frameworks, default values are described. In this section, default values for the most applied frameworks are given:

- Biocidal Products Regulation

The Guidance for biocides legislation, the Technical notes for Guidance (TNsG 2007), presents a default body weight for adults of 60 kg. Default values for children are divided into three age groups (Table 19). With the opinion of the Human Exposure Expert Group (HEEG 2013), adopted during the second technical meeting in 2013, the use of body weights for early-life groups is harmonized. The HEEG opinion recommends the default values for body weights (see Table 19).

Table 19: Default values for body weights from TNsG

	Infant (6-12 months)	Toddler (1-2 yr)	Child (6-11 yr)	Adult
Weight (kg)	8	10	23.9	60

- REACH

In the REACH guidance (Chapter R.15 Consumer exposure estimation, ECHA 2012), a default body weight of 70 kg for adult males and 60 kg for adult females is prescribed. The guidance refers, when necessary, to further analyses, particularly for estimations of children's exposure, to check 'Standards zur Expositionsabschätzung' (AUH 1995), the RIVM General Fact Sheet 2006 and US reports (AIHC 1994; US-EPA 1997).

- Plant Protection Products Regulation (PPP)

For the non-professionals, the Dutch part Evaluation manual PPP (European Commission 2009) assumes a body weight of 63 kg. Re-entry of treated lawns additionally assumes body weights for infants (8.69 kg) and for children (15 kg).

4.1.5 Data from other countries

The data and default parameters described in sections 4.1.1-4.1.3 are based on the Dutch population. However, data from outside the Netherlands are available and presented in the table below.

Table 20: Body weight data from other countries

Reference	Countries	Data	Remarks
US-EPA (2011b) Chapter 8 body weights	USA	Mean and several percentiles for body weight	Detailed distribution information available
ExpoFacts (database checked March 2014)	EU (18 countries)	Body weights for children and adults	Detailed information available
RefXP	Germany and USA	Mean and several percentiles for body weight	Detailed distribution information available
NEGh Report (2011)	Nordic countries	Review other sources	The NEGh finds the data presented in the US-EPA (2009) the most valid data for body weights

4.2 Total body surface area and surface are parts of the body

The total body surface area or surface area of parts of the body have not been measured to a large extent. In the past, therefore, empirical formulas have been used. The total surface area of the body is dependent on body height and weight. The surface area of the human body is dealt with in detail in Chapter 7 of the 'Exposure Factors Handbook' (US-EPA 2011c) and in the 'Report of the Task Group on Reference Man' of the International Commission on Radiological Protection (ICRP 1992) and relates to the surface area of body parts.
For body surface area, the following empirical formula is used (Gehan & George 1970):

$$SA = a_0 H^{a1} W^{a2}$$

in which: SA is the body surface area (in m^2)
H is the body height (in cm)
W is the weight (in kg)

Based on measurements of the surface area of people, and their weights and heights, different researchers have derived values for the constants. Based on these investigations, US-EPA (US-EPA 2011) considers the constants shown below to be the best choice:

$$SA = 0.02350\ H^{0.42246} W^{0.51456}$$

4.2.1 Data from General Fact Sheet 2006

For the body surface area and the surface areas of the different body parts, the General Fact Sheet 2006 chose to use the data described in section 4.1.1 and the above-mentioned formula (Gehan & George 1970). It appeared to predict the body surface area of children and adults very well. The default values from the General Fact Sheet 2006 are reported in Annex II.

4.2.2 New information

In the first version of the Exposure Factors Handbook (US-EPA 1997), the US-EPA used the above-mentioned empirical formula to calculate the body surface area of people. In the update in 2011, US-EPA (2011c) determined that this model is still the best formula of choice for estimating the total surface area of the body. In agreement with them, we adopted this formula for further calculations.

Section 4.1.2 explains the summary statistics of the dataset for the total body surface area for adults and children. Age group and sex-specific results for adults and children are reported in Table 22 and Tables 26 and 27, respectively. Reported 5^{th}, 25^{th}, 50^{th}, 75^{th} and 95^{th} percentiles are derived from the raw data (see Annex I) without assuming a distribution. In contrast to adults, GMs and CV are not reported for most early age groups of children, because visual inspection of the raw data (not shown) showed multimodal distributions.

Total body surface area for adults

Table 22 shows the summary statistics of the total body surface areas of men and women ages 18 to 70. The population distribution of the surface areas is distributed log-normally with the reported GM and CV.
The obtained GM is well in line with the surface areas derived by applying the equation of Gehan and George to the reported arithmetic mean body weights and heights from other recent studies (Table 21).

Table 21: Total body surface area of Dutch adults calculated based on data from recent studies

	Age (years)	Surface area (m^2)[a]	Reference
Men	>20	2.03	CBS (2014a)
	19-69	2.06	Van Rossum et al. (2011)
	18-70	2.06	Blokstra et al. (2011)
Women	>20	1.9	CBS (2014a)
	19-69	2.03	Van Rossum et al. (2011)
	18-70	1.81	Blokstra et al. (2011)
Adults	>20	1.92	CBS (2014a)
	19-69	1.96	Van Rossum et al. (2011)

[a] calculated body surface area, using the empirical formula described above using the body weight data (arithmetic mean) from Table 13.

Table 22: Modelled total body surface area (m^2) of Dutch adults (ages 18-70) (Annex I)

	Men	Women	Adults
GM[a]	2.09	1.84	1.96
CV[b]	1.09	1.09	1.11
5th percentile	1.81	1.60	1.65
25th percentile	1.97	1.73	1.82
50th percentile	2.09	1.84	1.96
75th percentile	2.21	1.94	2.11
95th percentile	2.40	2.11	2.33

[a] Geometrical Mean
[b] CV: Coefficient of Variation

Surface area of parts of the body (adults)
The US-EPA used the empirical formula for total body surface areas (see section above, US-EPA 2011c) to derive the surface areas of various parts of the body. However, different parameter values are applied for each specific part of the body for a_0, a_1 and a_2, separately for men and women. Table 24 describes the surface areas and percentages reported by US-EPA. Since data on individual (Dutch) body weight and height are available (section 4.1), surface areas of the various body parts could be derived for the Dutch situation. This probably results in the most accurate surface areas. However for practical reasons, in combination with an assumed small increase in quality, the surface areas are derived from the total surface areas reported in Table 22 and the percentages of each part of the body in respect of the total body surface area as reported by US-EPA (Table 23). Table 24 describes the surface areas of various parts of the body of Dutch adults as calculated using the practical method.

Note: Table 23 shows that the total surface area of body parts, the sum of the surface area of individual parts of the body, does not equal the reported total of US-EPA (2011). The sum of male percentages is 105-108% of the total body surface area, while the sum of female percentages is 98-99% of the total body surface area.

Table 23: Different percentiles of area of different body parts in m^2 and their percentages of the total body area of adults (US-EPA 2011c)

Male	Percentile / % of total body surface area					
	25th	%	50th	%	75th	%
head	0.131	6.8	0.136	6.6	0.143	6.4
trunk	0.74	38.3	0.82	39.6	0.918	41.2
arms (excl. hands)	0.289	15	0.316	15.3	0.346	15.5
hand	0.1	5.2	0.107	5.2	0.115	5.2
legs	0.634	32.8	0.686	33.1	0.746	33.5
feet	0.13	6.7	0.138	6.7	0.147	6.6
total body parts[a]	2.02	105	2.2	106	2.42	108
total US-EPA (2011)	1.93	-	2.07	-	2.23	-
Female	Percentile / % of total body surface area					
	25th	%	50th	%	75th	%
head	0.111	6.7	0.114	6.3	0.116	5.8
trunk	0.571	34.4	0.633	34.4	0.708	35.6
arms (excl. hands)	0.227	13.7	0.237	13.0	0.248	12.5
hand	0.082	4.9	0.087	4.8	0.094	4.7
legs	0.533	32.1	0.588	32.3	0.649	32.6
feet	0.113	6.8	0.121	6.6	0.13	6.5
total body parts[a]	1.64	99	1.78	98	1.95	98
total US-EPA (2011)	1.66	-	1.82	-	1.99	-

[a] The total surface area of the parts of the body, the sum of individual parts, does not equal the reported total of US-EPA (2011). The percentages are based the percentile part of the body versus the total presented by US-EPA (2011c).

Table 24: Percentiles of surface areas (m^2) of various parts of the body of Dutch adults

Men	Percentiles of the surface area[a]		
	25th	50th	75th
head	0.13	0.14	0.14
trunk	0.75	0.83	0.91
arms (excl. hands)	0.30	0.32	0.34
hand	0.10	0.11	0.11
legs	0.65	0.69	0.74
feet	0.13	0.14	0.15
Women	Percentiles of the surface area[a]		
head	0.12	0.12	0.11
trunk	0.60	0.64	0.69
arms (excl. hands)	0.24	0.24	0.24
hand	0.08	0.09	0.09
legs	0.56	0.59	0.63
feet	0.12	0.12	0.13

[a] Based on modelled total body surface areas from Table 23 and calculated using the US-EPA (2011c) percentages for men and women from Table 24

Total surface area of children

Table 26 and Table 27 show the summary statistics of the body surface area of boys and girls respectively (see section 4.1.1 for detailed description of calculation). These are not distributed log-normally, therefore no GM and CV are calculated. Surface areas for the separate ages (years) are distributed log-normally. Their GMs and CVs are provided in Annex I.

Table 25: Total body surface area (m^2) of Dutch children obtained from recent studies (Ocké et al. 2008)

	Age (years)	Arithmetic mean total body surface area (m^2)
Boys	2-3	0.66
	4-6	0.83
Girls	2-3	0.65
	4-6	0.83
Boys + girls	2-3	0.66[a]
	4-6	0.83[a]

[a] calculated average of arithmetic means for boys and girls not reported Ocké et al. (2008)

Because the obtained body weights of Table 26 and 27 are not distributed log-normally, they are difficult to compare with the arithmetic means of Table 25. The table 25 arithmetic means are derived by applying the equation described by Gehan and George (1970) to the reported arithmetic mean body weights and heights from Ocké et al. (2008).

Table 26: Modelled total surface area (m^2) of Dutch boys of different ages (see Annex I).

Age		Percentiles						
Months	years	5th	25th	50th	75th	95th	GM[a]	CV[b]
0-1		0.16	0.19	0.23	0.28	0.31		
1-3		0.25	0.28	0.31	0.34	0.37		
3-6		0.31	0.35	0.37	0.40	0.44		
6-12		0.38	0.42	0.45	0.48	0.53		
	1-2	0.44	0.48	0.53	0.59	0.65		
	2-3	0.53	0.58	0.62	0.67	0.73		
	3-6	0.61	0.69	0.76	0.83	0.93		
	2-6	0.55	0.64	0.72	0.81	0.92		
	6-11	0.81	0.93	1.07	1.22	1.39		
	11-16	1.24	1.41	1.56	1.71	1.91		
	16-18	1.59	1.73	1.84	1.95	2.12	1.84	0.087

[a] Geometrical Mean

[b] CV: Coefficient of Variation

Table 27: Modelled total surface area (m^2) of Dutch girls of different ages (see Annex I).

Age		Percentiles						
Months	years	5th	25th	50th	75th	95th	GM[a]	CV[b]
0-1		0.18	0.20	0.23	0.26	0.29		
1-3		0.24	0.27	0.30	0.32	0.36		
3-6		0.30	0.33	0.35	0.38	0.42		
6-12		0.36	0.40	0.43	0.46	0.51		
	1-2	0.42	0.46	0.51	0.57	0.63		
	2-3	0.51	0.56	0.61	0.65	0.72		
	3-6	0.60	0.68	0.75	0.82	0.92		
	2-6	0.54	0.62	0.71	0.80	0.91		
	6-11	0.80	0.93	1.06	1.21	1.39		
	11-16	1.23	1.39	1.52	1.65	1.83		
	16-18	1.49	1.62	1.72	1.82	1.97	1.72	0.086

[a] Geometrical Mean

[b] CV: Coefficient of Variation

Surface areas of parts of the body (children)

The General Fact Sheet 2006 presents percentages for the surface areas of various parts of the body of children. These percentages were based on data from various studies (Verweij et al. 1994; Fredriks et al. 2000; US-EPA 1997; ICRP 1992). In this updated report, the percentage of surface area for parts of the body of children calculated by the US-EPA (2011c) and Boniol et al. (2008) are combined with more recent data on body weight and height (De Wilde 2014; Table 26 and 27).

US-EPA (2011b) presents a table with recommended mean percentages for each surface area. For age groups 0 to 2 years, the US-EPA relies on their own default values (US-EPA 1997) based on measurements of four boys and girls. Data from Boniol et al. (2008) is the basis used for the default values for the age groups 2 21 years, in which measurement data taken from 2,050 boys and girls was used (from Snyder et al 1977). The reliability of this methodology was not verified for this updated fact sheet.

Using these two studies results in discrepancies between the absolute skin surface area of the heads of children and young adults, e.g. an unrealistic drop in the mean skin surface area of children in the age group 1 to <2 years old (from US-EPA 1997) and 2 to <3 years old (adapted from Boniol et al. 2008). In addition, doctors at Medical Centres for Fire Accident Victims use the Lund-Browder table (Lund and Browder 1944) for assessing percentages of skin burn that show similar data for children under 2 years old as stated in US-EPA (1997, 2011b). However, although Boniol et al. state that Lund and Browder's proportions largely overestimate the surface areas for the head and limbs, no other data for this age group are available. Above 2 years, data from Boniol et al. was preferred because it is based on a large measurement dataset and updated methodology (personal communication US-EPA, Moya J. 2014). In agreement with the approach of the US-EPA, this method was adopted for the calculation of new default values for the age group above 2 years.

Table 28 presents default percentages for the surface areas of various parts of the body. By multiplying these percentages by the total body surface area of Dutch children, the surface areas of parts of the body for boys and girls are derived. Table 29 presents the 25th percentile of body surface parts. The surface

areas of parts of the body based on other percentiles can be derived by multiplying the percentages given in Table 28 by the required percentile of the total body surface area from Tables 26 and 27. A worst-case scenario includes aggregate exposure of head and neck; therefore Table 31 provides default values for the head and neck combined, in contrast to default values given by US-EPA. Note that the values for head and neck in Tables 28 and 29 are presented separately.

Table 28: Recommended percentages (%) for Surface Area of Parts of the body adopted from US-EPA (2011b) and Boniol et al. (2008)

Age (years)	head	neck	trunk	Arms (excl. hands)	hands	Legs	feet
Boys							
0 to <1[a]	18.2	-	35.7	13.7	5.3	20.6	6.5
1 to <2[a]	16.5	-	35.5	13.0	5.7	23.1	6.3
2 to <3[b]	8.4	3.9	36.9	14.5	4.5	25.2	6.5
3 to <6[c]	8.25	3.85	37.15	14.3	4.65	25.25	6.5
2 to <6[b]	8.4	3.9	36.9	14.5	4.5	25.2	6.5
6 to <11[d]	6.9	3.2	36.8	14.3	4.9	27.1	6.7
11 to <16[e]	5.15	2.45	37.15	14.25	4.65	29.35	6.9
16 to <18[f]	4.0	2.0	37.4	15.4	4.7	30.0	6.7
Girls							
0 to <1[a]	18.2	-	35.7	13.7	5.3	20.6	6.5
1 to <2[a]	16.5	-	35.5	13.0	5.7	23.1	6.3
2 to <3[b]	8.4	3.8	37.4	14.2	4.8	25.4	6.0
3 to <6[c]	8.1	3.7	37.45	14.05	4.85	25.7	6.15
2 to <6[b]	8.4	3.8	37.4	14.2	4.8	25.4	6.0
6 to <11[d]	6.9	3.2	36.9	13.7	4.9	27.9	6.6
11 to <16[e]	5.05	2.4	36.65	14.0	4.5	30.8	6.6
16 to <18[f]	4.3	2.1	39.8	13.9	4.2	29.7	6.1

[a]Mean per cent of total surface area from (US-EPA 2011b). Note that head includes neck.
[b]Mean per cent of total surface area for 2 year old boys or girls (Boniol et al. 2008).
[c]Average per cent of total surface area for 2 and 4 year old boys or girls (Boniol et al. 2008)
[d]Mean per cent of total surface area for 6 year old boys or girls (Boniol et al. 2008)
[e]Average per cent of total surface area for 10 and 12 year old boys or girls (Boniol et al. 2008)
[e]Mean percent of total surface area for 16 year old boys or girls (Boniol et al. 2008)

Note: for an explanation of the discrepancy for surface area of head between the group 1-2 year-olds and 2-3 year-olds, see text above the table.

Table 29: Surface areas (m^2) of various parts of the body of Dutch children based on the 25th percentile of total surface area

Age		Surface area (m^2)						
Months	Years	head	neck	trunk	arms (excl. hands)	Hands	Legs	feet
Boys								
0-1		0.035		0.068	0.026	0.010	0.039	0.012
1-3		0.051		0.100	0.038	0.015	0.058	0.018
3-6		0.064		0.125	0.048	0.019	0.072	0.023
6-12		0.076		0.150	0.058	0.022	0.087	0.027
	1-2	0.079		0.170	0.062	0.027	0.111	0.030
	2-3	0.049	0.023	0.214	0.084	0.026	0.146	0.038
	3-6	0.057	0.027	0.256	0.099	0.032	0.174	0.045
	2-6	0.054	0.025	0.236	0.093	0.029	0.161	0.042
	6-11	0.064	0.030	0.342	0.133	0.046	0.252	0.062
	11-16	0.073	0.035	0.524	0.201	0.066	0.414	0.097
	16-18	0.069	0.035	0.647	0.266	0.081	0.519	0.116
Girls								
0-1		0.036		0.071	0.027	0.011	0.041	0.013
1-3		0.049		0.096	0.037	0.014	0.056	0.018
3-6		0.060		0.118	0.045	0.017	0.068	0.021
6-12		0.073		0.143	0.055	0.021	0.082	0.026
	1-2	0.076		0.163	0.060	0.026	0.106	0.029
	2-3	0.047	0.022	0.207	0.081	0.025	0.141	0.036
	3-6	0.056	0.026	0.253	0.097	0.032	0.172	0.044
	2-6	0.052	0.024	0.229	0.090	0.028	0.156	0.040
	6-11	0.064	0.030	0.342	0.133	0.046	0.252	0.062
	11-16	0.072	0.034	0.516	0.198	0.065	0.408	0.096
	16-18	0.065	0.032	0.606	0.249	0.076	0.486	0.109

4.2.3 *Default values for surface area and parts of the body for adults and children*

Table 30 provides the default values for the total body surface area (m^2) and the surface area of parts of the body (m^2 and %) for adults. The deterministic point values are obtained from the 25th percentiles of the Tables 22, 23 and 24 above. Deterministic default values for the parts of the body of men and women together are not available from the calculations presented above (see Table 24). Therefore, the calculated average from the 25th percentile for men and women are set as default values for adults.

Default values which can be used for probabilistic assessments are considered to be distributed log-normally with the reported GMs and CVs (see Table 22). Probabilistic default values are not derived for the various parts of the body.

Since the default values are reliable, based on good quality, relevant data, the default values for total surface area are assigned a Q-factor of 4. However, for practical reasons, the surface areas of the parts of the body are derived as

percentages of the total surface area (see section 4.2.2). Therefore, these default values are assigned a Q-factor of 3.

Table 30: Deterministic default values of the surface area and surface areas of different parts of the body and information on their distribution.

	Men		Women		Adults[c]		Q-factor
Surface area	m^2	%	m^2	%	m^2	%	
Total							
Deterministic[a]	1.97		1.73		1.82		4
Probabilistic[b]							
GM	2.09		1.84		1.96		4
CV	1.09		1.09		1.11		
Head	0.13	6.8	0.12	6.7	0.12	6.75	3
Trunk	0.75	38.3	0.60	34.4	0.66	36.35	3
Arms	0.30	15	0.24	13.7	0.26	14.35	3
Hands	0.10	5.2	0.08	4.9	0.09	5.05	3
Legs	0.65	32.8	0.56	32.1	0.59	32.45	3
Feet	0.13	6.7	0.12	6.8	0.12	6.75	3

[a] Deterministic default value is 25th percentile

[b] Body weight distribution for probabilistic calculations (GM: Geometrical Mean and CV: Coefficient of Variation)

[c] For percentage of adults, the average of men and women is assumed

Table 31 provides the default values for children's body weight (kg), surface area (m^2) and surface area of parts of the body (m^2 and %). The deterministic point values are obtained from the 25th percentiles of the above Tables (18, 28 and 29). The calculated average 25th percentile values of boys and girls are set as defaults for children (i.e. boys and girls) combined. The distributions of body weights and surface areas for grouped ages showed multimodal distributions, which cannot straightforwardly be characterized with a (geometric) mean and coefficient of variation (see Annex I). Therefore, no probabilistic default values are reported here. However, distribution characteristics of the separate ages are provided in Annex I.

Table 31: Deterministic default values of the body surface of children of different ages.

Age		Body surface area (m^2)		Surface area of parts of the body												
Mon-ths	years	Default	Q-factor	Head (incl. neck)		Trunk (excl. neck)		Arms (excl. hands)		Hands		Legs		Feet		Q-factor
				(%)	(m2)	(%)	(m2)	(%)	(m2)	(%)	(m2)	(%)	(m2)	(%)	(m2)	
0-1[a]		0.20	4	18.2	0.036	35.7	0.071	13.7	0.027	5.3	0.011	20.6	0.040	6.5	0.013	3
1-3[a]		0.28	4	18.2	0.051	35.7	0.100	13.7	0.038	5.3	0.015	20.6	0.058	6.5	0.018	3
3-6[a]		0.34	4	18.2	0.062	35.7	0.121	13.7	0.047	5.3	0.018	20.6	0.070	6.5	0.022	3
6-12[a]		0.41	4	18.2	0.075	35.7	0.146	13.7	0.056	5.3	0.022	20.6	0.084	6.5	0.027	3
	1-2[a]	0.47	4	16.5	0.078	35.5	0.167	13	0.061	5.7	0.027	23.1	0.109	6.3	0.030	3
	2-3[b]	0.57	4	12.3	0.070	37.2	0.212	14.4	0.082	4.7	0.027	25.3	0.144	6.3	0.036	3
	3-6[c]	0.69	4	12.0	0.082	37.3	0.257	14.2	0.098	4.8	0.033	25.5	0.176	6.3	0.044	3
	2-6[b]	0.63	4	12.3	0.077	37.2	0.234	14.4	0.090	4.7	0.029	25.3	0.159	6.3	0.039	3
	6-11[d]	0.93	4	10.2	0.094	36.9	0.343	14	0.130	4.9	0.046	27.5	0.256	6.7	0.062	3
	11-16[e]	1.40	4	7.4	0.105	36.9	0.517	14.1	0.198	4.6	0.064	30.1	0.421	6.8	0.095	3
	16-18[f]	1.68	4	6.2	0.104	38.6	0.648	14.7	0.246	4.5	0.075	29.9	0.501	6.4	0.108	3

[a]Mean per cent of total surface area from (US-EPA 2011). Note that head includes neck.

[b]Mean per cent of total surface area of 2–year-old boys and girls (Boniol et al. 2008)

[c]Average per cent of total surface area of 2 and 4-year-old boys and girls (Boniol et al. 2008)

[d]Mean per cent of total surface area of 6-year-old boys and girls (Boniol et al. 2008)

[e]Average per cent of total surface area of 10 and 12-year-old boys and girls (Boniol et al. 2008)

[f]Mean per cent of total surface area of 16-year-old boys and girls (Boniol et al. 2008)

Although the percentages of surface area of parts of the body for 0 to 2-year-old children are probably overestimated, the data is satisfactory for deriving default values for the surface area of parts of the child's body. For the older early-age groups, the default values are assumed reliable, based on good quality, relevant data. The defaults are assigned a Q-factor of 3.

4.2.4 Legal frameworks

Within different guidance documents linked to legal frameworks, default values are described. In this section, defaults of the most applied frameworks are given:

- Biocidal Products Regulation

The Biocidal Products Regulation uses the Guidance for biocides legislation Technical notes for Guidance (TNsG 2007). The TNsG does not present default values for total body surface area for adults and children. With the HEEG opinion (2013), adopted during the second technical meeting in 2013, the use of total body surface area and surface area parts of the body for early-life groups and adults was set and harmonized (see Table 32).

Table 32: Default values for body part surface areas (HEEG opinion 2013)

Body surface area (cm2)	Infant (6-12 months)	Toddler (1-2 years)	Child (6-11 years)	Adult (>18 years)
Head	344.4	403.2	529	1,110
Trunk	1,533.4	1,795.2	3,376.4	5,710
Upper arms (both)	352.6	412.8	772.8	1,141.2
Lower arms (both)	229.6	268.6	496.8	1,128.8
Total arms (both upper and lower)	582.2	618.6	1,269.6	2270
Hands (both front and back)	196.8	230.4	427.8	820
Legs (both)	1,041.4	1,219.2	2,741.6	5,330
Feet (both)	246	288	604.9	1,130
Total	4,100	4,800	9,200	16,600

- REACH

In the REACH guidance (Chapter R.15 Consumer exposure estimation, ECHA 2012), a default body surface area of the male hand (840 cm^2) is used as an example. The guidance mentions that when more in depth information is needed (for body surfaces) information can be used from the AIHC "Exposure Factors Sourcebook" (1994) , the US-EPA Exposure factors handbook (US-EPA 1997), 'Standards zur Expositionsabschätzung' (AUH 1995) and the RIVM General Fact Sheet (2006).

According to the guidance, the total body surface (Sder,tot) can be calculated from the bodyweight (BW) and the body height (BH) using the formula:

$$SA = 0.0239\, H^{0.417} W^{0.517}$$

Table 33: Default values of surface areas of parts of the body under REACH (ECHA 2012)

	Mean surface area men (cm^2)	Mean surface area women (cm^2)
Head	1,180	1,028
Trunk	5,690	4,957
Upper extremities	3,190	2,779
Arms	2,280	1,984
Upper arms	1,430	1,244
Forearms	1,140	992
Hands (fronts and backs)	840	731
Lower extremities	6,360	5,533
Legs	5,060	4,402
Thighs	1,980	1,723
Lower legs	2,070	1,801
Feet	1,120	1,001
Total	19,400	16,900

4.2.5 *Data from other countries*

The data and default parameters described above are based on the Dutch population. However, data from outside the Netherlands are available and is presented in the table below.

Table 34: Surface area data from other countries

Reference	Countries	Data	n	Remarks
US-EPA (2011) Chapter 7 dermal exposure factors	USA	Mean and several percentiles for body surface area and surface area parts of the body available	Numbers available for sex and age groups	Detailed distribution information available
ExpoFacts (database checked March 2014)	EU (18 countries)	Body weights for children and adults	-	Detailed information available
RefXP (database checked May 2014)		Mean and several percentiles for body surface area		Information is from before 2000 (Public use File BGS98, Bundesgesundheitssurvey 1998, Robert Koch-Institut, Berlin 2000)
NEGh Report (2011)	Nordic countries	Review other sources	-	The NEGh concludes that the data presented in US-EPA (2009) are the most valid data for total body surface area and surface area parts of the body

4.3 Inhalation rates

4.3.1 Data General Fact Sheet 2006

In the General Fact Sheet 2006, information on inhalation rates was not included. The ConsExpo tool calculates inhalation rates based on body weight and activity pattern (sleep, rest, light or heavy exercise), parameters that need to be filled in and can be adapted for specific assessments.
The empirical formula used for the calculation of inhalation rates is based on Freijer et al. (1997):

Sleep	$Q_{inh} = 0.8 \times Bw^{0.6}$ (m^3/day)
Rest	$Q_{inh} = 1.05 \times Bw^{0.6}$ (m^3/day)
Light exercise	$Q_{inh} = 2.3 \times Bw^{0.65}$ (m^3/day)
Heavy exercise	$Q_{inh} = 11.0 \times Bw^{0.45}$ (m^3/day)

4.3.2 New information

For comparison reasons, the inhalation rates provided in this section are calculated using the newly derived default values for body weight as an illustration.

In the following tables, data on inhalation rates are given for adults and children based on different activity patterns and calculated by ConsExpo.

Table 35: Inhalation rates of Dutch adults based on activity pattern and default body weight (see section 4.1) for illustration purposes

		Activity (m3/h)[a]			
	Bw (kg)	Sleep	Rest	Light exercise	Heavy exercise
Men	77.2	0.45	0.59	1.61	3.24
Women	64.1	0.4	0.53	1.43	2.98
Adults	68.8	0.42	0.55	1.49	3.07

[a] *The inhalation rate calculation is based on Freijer et al. (1997)*

Table 36: Inhalation rates of children as based on activity pattern and default body weight (see section 4.1)

		Inhalation rate (m^3/h)[a]			
	Bw (kg)	Sleep	Rest	Light exercise	Heavy exercise
neonatal (0 to <1 months)	2.4	0.05	0.07	0.16	0.67
Infant (1 to > 3 months)	4.5	0.08	0.1	0.25	0.9
Infant (3 to <6 months)	6.1	0.09	0.12	0.31	1.03
infant (6 to <12 months)	8.0	0.11	0.15	0.36	1.16
toddler (1 to <2 years)	9.8	0.13	0.17	0.42	1.27
early childhood (2 to <3 years)	12.4	0.15	0.19	0.49	1.42
early childhood (3 to <6 years)	15.7	0.17	0.22	0.57	1.58
early childhood (2 to <6 years)	14.3	0.16	0.21	0.53	1.51
middle childhood (6 to <11 years)	24.3	0.22	0.29	0.76	1.92
early adolescence (11 to <16 years)	44.8	0.32	0.42	1.13	2.53
early adolescence (16 to 18 years)	59.3	0.38	0.5	1.36	2.87

[a] The inhalation rate calculation is based on Freijer et al. (1997) as used in ConsExpo (Delmaar et al. 2005)

4.3.3 *Default values inhalation rates*

No default values for inhalation rates are provided. However, when the default values for body weight are used, ConsExpo calculations result in the values for inhalation rate as provided in Table 35 and 36.

4.3.4 *Legal Frameworks*

Default values are described within different guidance documents linked to legal frameworks. In this section, default values of the most applied frameworks are given:

- Biocidal Products Regulation

Within the Guidance for biocides legislation, the Technical notes for Guidance (TNsG 2007) are used. In a recent opinion issued by the HEEG, inhalation rates for children and adults are given for both short and long-term inhalation rates.

Table 37: Inhalation rates according to HEEG opinion (2013)

Age	Short (m^3/h)	Long (m^3/24 h)
Infant (0<1 year)	0.84	5.4
Toddler (2 years)	1.26	8
Child (6<11 years)	1.32	12
Adult (> 18 years)	1.25	16

- REACH

In the REACH guidance (Chapter R.15 Consumer exposure estimation, ECHA 2012), the first tier inhalation default is set at 20 m^3/day. When necessary, the inhalation rate can be adapted for age, as well as short and long-term inhalation rates (see Table 38).

Table 38: Inhalation rates provided in the REACH guidance (ECHA, 2012)

	Short term (m^3/h)[a]				Long term (m^3/24 h)
Age (years)	Rest	Light	Medium	Heavy	
Child					
<1	0.06	0.12	0.24	0.42	3
1-3	0.12	0.24	0.50	0.83	7
4-6	0.24	0.50	0.96	1.67	11
7-9	0.36	0.50	1.46	2.54	14
10-14	0.50	0.96	1.92	3.38	18
15-19	0.54	1.08	2.13	3.79	20
Adults					
20-75	0.54	1.08	2.13	3.79	18

[a] Inhalation rates recalculated from m^3 per day

4.3.5 *Data from other countries*

Data and default parameters described above are based on the Dutch population. However, data from outside the Netherlands are available and presented in the table below.

Table 39: Data on inhalation rate from other countries

Reference	Countries	Data	N	Remarks
US-EPA (2011d) Chapter 6 Inhalation rates	USA	Mean and several percentiles for inhalation rate and activity pattern, short and long term available	Numbers available for sex and age groups	Detailed distribution information available
ExpoFacts (database checked March 2014)	Italy	Mean and SD Awake asleep	 61-126 61-126	Study from 1994 for age categories. Age range is 0 to 36 years
NEGh Report (2011)	Nordic countries			The NEGh finds the data presented in the US-EPA (2009) the most valid data for inhalation rates

5 Activity patterns

In recent years, several papers and reports have been published on the time activity patterns of consumers. At the same time, it was noticed that, when establishing an exposure scenario, in many cases information on how and where activity takes place (indoor/outdoor or in the car/home/office) and how much time the activity takes is necessary for performing an exposure assessment for consumers. This chapter provides an overview on general activities; scenario-specific information is given in product specific fact sheets.

5.1 Time activity patterns

5.1.1 Data General Fact Sheet 2006

This information was not included at the time.

5.1.2 New information

The CBS performs surveys on a regular basis focused on time activity patterns in the Netherlands in which time is distinguished into three main categories (Cloin et al. 2013):

- Mandatory time (going to school, working hours, housekeeping and caring)
- Personal time (sleeping and eating)
- Leisure time

In the Netherlands, 25% of the weekly hours is spent as mandatory time. Adult women are spending more time on housekeeping than men (25 versus 12.4 hours per week). In addition, women are spending twice as much time at cooking and cleaning than men.

Personal time covers 46% of the weekly hours. Dutch men and women (>12 years) spend an average of 8.5 hours per day sleeping. Women tend to sleep almost two hours per week more than men. Approximately 6 hours per week are spent on physical care, such as personal hygiene, cosmetics and getting dressed.

Leisure covers 28% of the weekly hours, 40% of which is spent using different media, such as reading, watching television or using the computer.

Parents with a child below the age of 4 years have the least free time, while persons above the age of 40 years have the most time for leisure.

5.1.3 Legal frameworks

These types of data are not set at default values within REACH guidance or Technical Notes of Guidance for Biocides.

5.1.4 Data from other countries

The data described above is based on the Dutch population. However, several data from outside the Netherlands are available and a selection is presented in the table below.

Table 40: Data on time activity patterns from other countries

Reference	Country	Data	n
Schweizer et al. (2007)	Finland, Greece, Switzerland, France, Italy, Czech Republic and UK	Time spent indoors, at home, at work, and elsewhere. Time exposed to tobacco smoke indoors.	1,427 (age 19-60)
Guillam et al. (2010)	France	Time spent by children indoors at places of leisure (e.g. bars, sport, theatres) and day-care centres	2,780 (age 0-18)
Wu et al. (2011)	USA (California)	Time spent in an activity or various locations (shop, work, eating, transit) for week/weekend day every 3 months over 18-month period	150 (age under 8) 151 parents (age under 55), 55 adults (age above 55)
Isaacs et al. (2013)	USA	Time spent in different activities (sleep, work, shop, motor vehicle, outdoor activities) over a two-year period. Day-type, season, temperature, and gender are described.	8 (four male, four female)
Brasche & Bischof (2005)	Germany	Time spent in home classified by various factors (e.g. gender, location, building type, smoking, ventilation)	5,530 homes
Conrad et al. (2013)	Germany	Reference values and distributions of time-location patterns, residential environment and physical activity of children	1,790 (age 3-14)

Reference	Country	Data	n
HETUS (Harmonized Europe Time Use Survey) Database checked April 2014	Germany, Finland, France, Italy, Norway, Sweden, Spain, United Kingdom, Bulgaria, Latvia, Estonia, Belgium, Poland, Slovakia and Lithuania.	Survey data of organization and activities of every-day life in European Countries.	15 European countries
Hertz-Picciotto et al. (2010)	Northern California	Seasonal and long-term changes in exposure-related behaviours including food consumption, temporal-spatial activity and household product use	499 parents 156 55+ adults
Consolidated Human Activity Database (CHAD) Database checked April 2014	United States of America	Specified characteristics suitable for exposure assessment; 24 hr time activity	22.968 person days of activity
Matz et al. (2014) (Canadian Human Activity Pattern Survey 2)	Canada	24 hour diaries, information on specific pollutants, dwelling characteristics, socio-economic factors, time spent indoors, outdoors, vehicle	5,011 participants in five urban and two rural locations, all ages
Buonanno et al. (2014)	Central Italia	Indoor time, transport, sleeping time, outdoor, cooking, working. Separated by summer and winter	24 couples (48 persons)
ExpoFacts (database checked April 2014)	Europe	Database of time use published in different studies	
Hussein et al. (2012)	Finland	Time spent indoors (home, school, work), outdoors, in traffic during three time periods in winter and spring	167 persons between 2 and 93 years old

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Annex I Derivation of body weight, length and surface area corrected for population distributions of age, sex and ethnicity

Recent anthropomorphic data are available on the body weight and height of children from the city of The Hague and of adults throughout the Netherlands (Table A1). The body weight and height are used to derive the body surface area for each individual in the dataset. For body surface area, the following empirical formula is used (see US-EPA 2011c):

$$SA = a_0 H^{a1} W^{a2}$$

in which:

SA is the body surface area (in m^2)
H is the body height (in cm)
W is the body weight (in kg)

Based on measurements of the surface area of people, and their weights and heights, different researchers have arrived at values for the constants. On the basis of these investigations, EPA considers the constants shown below to be the best choice:

$$SA = 0.02350 * H^{0.42246} * W^{0.51456}$$

From research on children and adults, the above parameters appeared to predict the body surface area of both very well.

Table A1: datasets used to derive body weight, height and surface area corrected for population distributions of age, sex and ethnicity

Years of recording	Age (years)	Number of records	Location
2008-2010	0-2	91482	The Hague
2007-2011	2-15	117883	The Hague
2006-2007	16	41	The Hague
2009-2010	18-71	4484	The Netherlands

The dataset of the children from The Hague is conveniently large; but it has some drawbacks. Children were measured on multiple occasions within a year or during the period of recording. As a consequence, multiple records of the same individuals are included in the dataset. Moreover, the data are not distributed evenly across the age groups. Additionally, in some age groups no data are collected at all. For example, no data were included for children aged 7, 8, 11, 12 and 17 and only limited data were included for 16-year-olds. The final drawback of this dataset from De Wilde (2014) is the fact that the distribution of individuals over various ethnic groups is not representative of the entire Dutch population.
The data on adults (age 18-71; Blokstra et al. 2013) probably contain the same drawbacks, i.e. they do not represent the actual Dutch population distribution in terms of age, sex and ethnicity.

To circumvent the above-described unrepresentative distributions of the measurements over age, sex and ethnicity — i.e. to derive weighted body weights, heights and surface areas — the following actions are taken.

A description of the realistic composition of the Dutch population is obtained from the CBS (Statistics Netherlands 2014b) (Table A2). The CBS provides online, up-to-date information on the age, gender and ethnicity composition of the Dutch population. CBS information of January 2010 is used because it lies close to or within the time period the children and adults were measured. The anthropometric data are subdivided into fourteen sex and ethnicity groups, i.e. Antillean, (native) Dutch, Moroccan, Turkish, Surinamese, other Western and other non-Western men and women.

Table A2: Distribution over age, sex and ethnicity of the Dutch population in January 2010

ethnicity	Total population		(native) Dutch		other Western (Dutch)		Turkish		Moroccan		Suriname		Antillean		Other non-Western	
sex	Men	women	men	women	men	women	men	women	men	women	men	women	men	women	men	women
Age (years)																
0	94,400	90,186	71,474	68,465	7,132	6,624	2,667	2,521	3,743	3,661	1,788	1,659	1,129	1,117	6,467	6,139
1	95,024	90,191	71,791	68,017	6,950	6,659	2,826	2,741	3,977	3,747	1,845	1,741	1,184	1,166	6,451	6,120
2	92,895	89,211	69,989	67,142	6,844	6,421	3,008	2,808	3,843	3,826	1,844	1,762	1,112	1,147	6,255	6,105
3	95,057	90,395	72,038	68,220	6,714	6,366	3,063	2,932	3,940	3,950	1,965	1,835	1,081	1,048	6,256	6,044
4	95,998	91,524	72,723	69,384	6,655	6,318	3,223	3,019	4,114	3,984	2,017	1,869	1,029	1,056	6,237	5,894
5	98,694	94,651	75,335	72,214	6,719	6,506	3,200	3,052	4,071	3,890	2,162	2,023	1,069	1,002	6,138	5,964
6	102,325	97,569	79,011	75,203	6,583	6,435	3,223	3,162	4,107	3,836	2,289	2,141	1,068	1,078	6,044	5,714
7	102,843	97,974	79,452	75,777	6,657	6,180	3,387	3,164	3,870	3,778	2,432	2,210	1,140	1,104	5,905	5,761
8	103,609	99,080	80,161	76,916	6,570	6,250	3,506	3,247	3,812	3,652	2,567	2,378	1,167	1,057	5,826	5,580
9	105,337	101,167	81,726	78,542	6,630	6,370	3,583	3,472	3,821	3,683	2,551	2,462	1,107	1,099	5,919	5,539
10	103,381	98,392	80,496	76,622	6,584	6,139	3,571	3,412	3,535	3,352	2,572	2,487	1,134	1,127	5,489	5,253
11	102,594	97,917	79,946	76,350	6,455	6,083	3,796	3,504	3,404	3,348	2,495	2,384	1,166	1,123	5,332	5,125
12	99,277	95,549	76,829	74,195	6,437	6,016	3,724	3,571	3,224	3,193	2,604	2,423	1,137	1,060	5,322	5,091
13	99,576	93,992	77,286	73,047	6,641	6,159	3,611	3,413	3,216	3,030	2,427	2,446	1,206	1,049	5,189	4,848
14	99,298	94,805	77,337	73,876	6,548	6,161	3,540	3,277	3,088	2,981	2,547	2,424	1,235	1,144	5,003	4,942
15	102,235	97,580	79,687	76,081	6,636	6,285	3,769	3,487	3,219	3,010	2,553	2,497	1,273	1,209	5,098	5,011
16	102,041	97,587	79,537	76,227	6,690	6,287	3,581	3,535	3,200	3,007	2,681	2,611	1,226	1,132	5,126	4,788
17	103,636	98,488	80,233	76,495	6,618	6,630	3,771	3,483	3,269	3,173	2,815	2,624	1,300	1,209	5,630	4,874
18	105,120	100,731	81,392	78,103	7,157	6,912	3,790	3,460	3,158	3,053	2,866	2,858	1,371	1,348	5,386	4,997
19	106,290	101,715	81,794	77,722	7,553	7,704	3,710	3,437	3,200	3,029	2,959	2,949	1,450	1,568	5,624	5,306
20	102,284	99,762	77,590	75,101	7,955	8,684	3,714	3,359	3,118	2,880	2,908	2,896	1,513	1,497	5,486	5,345
21	102,229	99,743	76,944	73,894	8,545	9,847	3,464	3,243	2,991	2,898	3,003	2,941	1,497	1,484	5,785	5,436
22	103,411	100,464	78,134	74,336	9,012	9,956	3,252	3,127	2,845	2,881	2,872	3,045	1,535	1,527	5,761	5,592
23	102,871	101,473	76,604	74,443	9,509	10,438	3,123	3,075	2,687	2,835	3,048	3,088	1,540	1,561	6,360	6,033

ethnicity	Total population		(native) Dutch		other Western (Dutch)		Turkish		Moroccan		Suriname		Antillean		Other non-Western	
sex	Men	women	men	women	men	women	men	women	men	women	men	women	men	women	men	women
Age (years)																
24	101,121	99,552	74,174	71,613	9,568	10,643	3,091	3,197	2,731	3,048	3,005	3,098	1,554	1,553	6,998	6,400
25	100,842	98,516	72,673	69,464	10,008	10,880	3,221	3,472	2,675	3,216	3,001	3,073	1,522	1,516	7,742	6,895
26	98,330	96,808	70,423	67,574	10,044	11,030	3,248	3,461	2,680	3,301	2,763	3,120	1,519	1,468	7,653	6,854
27	99,358	97,758	71,108	68,338	10,347	11,307	3,453	3,427	2,772	3,371	2,701	3,016	1,528	1,389	7,449	6,910
28	101,361	100,968	73,205	71,219	10,653	11,673	3,830	3,883	2,886	3,401	2,578	2,830	1,399	1,369	6,810	6,593
29	103,121	102,293	75,233	72,398	10,813	11,983	3,841	3,754	2,819	3,437	2,525	2,812	1,389	1,309	6,501	6,600
30	99,997	99,245	72,763	70,510	10,637	11,661	3,869	3,562	3,007	3,449	2,433	2,699	1,244	1,210	6,044	6,154
31	100,187	100,158	73,586	71,199	10,568	11,925	3,822	3,700	2,894	3,346	2,399	2,642	1,190	1,143	5,728	6,203
32	98,924	98,810	72,991	70,557	10,294	11,640	3,716	3,540	3,062	3,449	2,330	2,730	1,165	1,121	5,366	5,773
33	100,497	99,509	75,227	72,423	10,402	11,566	3,308	3,225	2,909	3,060	2,409	2,540	1,124	968	5,118	5,727
34	101,108	101,123	75,610	73,579	10,413	11,604	3,432	3,373	2,937	3,053	2,305	2,681	1,056	983	5,355	5,850
35	105,666	105,754	79,736	77,394	10,300	11,861	3,820	3,853	3,133	3,086	2,418	2,769	1,009	953	5,250	5,838
36	109,664	109,887	83,615	81,672	10,519	11,817	3,747	3,942	3,034	2,856	2,529	2,901	1,043	993	5,177	5,706
37	118,799	119,436	91,466	90,081	11,305	12,447	3,770	3,841	3,001	2,785	2,794	3,269	1,189	1,089	5,274	5,924
38	125,616	124,469	97,847	95,127	11,676	12,752	3,950	3,794	3,165	2,738	2,887	3,411	1,124	1,113	4,967	5,534
39	131,661	129,997	102,765	100,342	12,146	13,038	3,956	3,666	3,147	2,657	2,819	3,388	1,060	1,022	5,768	5,884
40	135,172	132,610	106,376	103,627	12,591	13,462	3,858	3,309	2,958	2,550	2,982	3,366	1,040	980	5,367	5,316
41	129,528	127,274	101,567	99,405	12,195	12,874	3,670	3,049	2,938	2,282	2,715	3,240	914	988	5,529	5,436
42	128,787	125,866	102,304	99,616	12,112	13,025	2,926	2,326	2,623	1,911	2,706	3,184	924	922	5,192	4,882
43	129,819	126,575	102,581	100,002	11,882	12,646	3,729	3,117	2,850	2,014	2,664	3,255	869	848	5,244	4,693
44	132,446	128,703	104,989	102,057	12,248	12,905	3,813	3,074	2,543	1,760	2,693	3,226	876	933	5,284	4,748
45	134,485	131,356	107,240	104,680	12,081	13,006	3,579	2,924	2,651	1,772	2,843	3,373	908	928	5,183	4,673
46	132,465	129,325	106,977	104,201	11,598	12,448	3,097	2,408	2,319	1,618	2,747	3,325	895	903	4,832	4,422
47	129,670	127,697	105,037	102,885	11,225	12,187	2,970	2,398	2,167	1,566	2,566	3,382	921	884	4,784	4,395
48	128,270	126,711	105,205	103,781	11,166	11,953	2,412	1,803	1,966	1,406	2,551	3,143	856	871	4,114	3,754

ethnicity	Total population		(native) Dutch		other Western (Dutch)		Turkish		Moroccan		Suriname		Antillean		Other non-Western	
sex	Men	women	men	women	men	women	men	women	men	women	men	women	men	women	men	women
Age (years)																
49	125,236	123,342	102,037	99,774	10,787	11,702	2,772	2,318	1,898	1,507	2,368	3,034	819	911	4,555	4,096
50	123,764	122,533	102,525	100,677	10,616	11,720	2,039	1,519	1,498	1,250	2,466	3,045	757	810	3,863	3,512
51	120,485	119,257	100,328	98,161	10,373	11,306	1,535	1,244	1,403	1,367	2,345	2,905	750	867	3,751	3,407
52	117,885	117,054	98,861	96,539	10,208	11,420	1,364	987	1,081	1,202	2,256	2,779	704	840	3,411	3,287
53	116,198	114,803	97,248	94,853	10,156	11,126	1,639	1,248	1,052	1,169	2,167	2,654	679	742	3,257	3,011
54	112,707	112,681	94,867	93,393	10,116	11,062	1,229	1,220	911	1,050	2,095	2,445	628	760	2,861	2,751
55	111,675	110,480	94,382	91,592	10,145	10,993	883	1,125	849	1,132	2,054	2,378	615	669	2,747	2,591
56	109,787	108,924	92,985	90,897	10,205	10,923	763	970	833	1,013	2,011	2,224	590	663	2,400	2,234
57	110,111	108,833	93,304	90,928	10,508	11,219	864	948	850	1,082	1,784	1,973	536	616	2,265	2,067
58	106,267	104,948	90,268	88,082	10,521	11,034	651	849	662	811	1,648	1,855	499	592	2,018	1,725
59	106,483	105,336	89,829	87,853	10,795	11,259	1,049	1,304	955	981	1,457	1,606	495	548	1,903	1,785
60	107,700	106,427	91,657	89,974	11,063	11,291	881	1,100	803	651	1,332	1,510	420	528	1,544	1,373
61	110,689	109,151	94,402	92,888	11,295	11,274	788	1,036	1,069	670	1,275	1,417	385	481	1,475	1,385
62	115,351	115,160	99,191	99,113	11,610	11,636	777	918	930	571	1,137	1,328	386	473	1,320	1,121
63	118,848	117,723	103,825	103,051	10,589	10,693	828	813	902	519	1,155	1,225	366	392	1,183	1,030
64	84,322	84,636	72,158	72,836	7,998	7,808	962	952	877	503	1,023	1,218	329	412	975	907
65	87,032	87,996	75,538	76,686	7,688	7,843	824	841	985	492	844	991	319	336	834	807
66	81,738	82,768	70,751	72,285	7,441	7,454	760	750	964	425	821	869	234	262	767	723
67	74,518	76,106	63,120	64,779	7,707	8,047	964	825	1,158	624	712	903	223	266	634	662
68	69,792	72,202	58,972	61,728	7,648	7,844	971	628	834	409	656	849	148	223	563	521
69	69,972	73,825	58,261	62,677	7,920	8,128	1,160	721	1,297	786	612	744	165	210	557	559
70	65,559	70,843	55,506	60,673	7,122	7,797	896	543	710	447	597	699	133	185	595	499
71	62,729	68,429	53,106	58,734	6,882	7,390	787	515	851	506	514	663	109	161	480	460
72	57,093	63,971	48,555	55,220	6,209	6,792	648	421	710	370	469	575	88	146	414	447
73	54,920	62,849	47,030	54,361	5,885	6,708	483	337	701	336	371	584	75	154	375	369

ethnicity	Total population		(native) Dutch		other Western (Dutch)		Turkish		Moroccan		Suriname		Antillean		Other non-Western	
sex	Men	women	men	women	men	women	men	women	men	women	men	women	men	women	men	women
Age (years)																
74	51,573	60,592	44,665	52,601	5,294	6,374	349	297	508	295	380	560	73	92	304	373
75	48,634	59,174	42,499	51,817	4,716	6,025	349	258	390	198	323	477	69	122	288	277
76	45,298	56,856	39,950	50,082	4,176	5,553	331	266	250	116	289	440	53	111	249	288
77	43,729	56,911	38,790	50,472	3,953	5,349	199	198	271	110	239	396	37	110	240	276
78	40,189	54,282	36,012	48,474	3,452	4,901	130	157	141	73	206	377	45	72	203	228
79	37,617	53,137	33,754	47,478	3,137	4,791	103	135	236	128	186	330	35	56	166	219
80	33,113	49,194	30,010	44,129	2,625	4,377	69	109	70	36	185	289	23	66	131	188
81	30,029	47,001	27,256	42,300	2,389	4,068	49	85	63	25	123	302	21	55	128	166
82	26,417	42,887	24,151	38,638	1,978	3,770	33	54	57	29	97	210	16	37	85	149
83	23,488	40,794	21,482	36,815	1,765	3,501	24	66	36	19	95	217	15	38	71	138
84	20,449	37,936	18,806	34,096	1,437	3,388	14	34	41	20	85	235	7	31	59	132
85	17,520	35,662	16,129	32,231	1,231	3,098	12	35	18	9	70	155	7	24	53	110
86	15,461	32,788	14,290	29,769	1,053	2,738	7	21	11	3	58	133	6	30	36	94
87	12,779	28,403	11,869	26,005	806	2,180	3	17	7	5	53	125	6	10	35	61
88	10,605	25,204	9,816	22,975	688	2,025	6	10	8	4	52	116	7	20	28	54
89	8,572	21,825	8,004	20,050	509	1,595	0	18	10	16	30	82	5	21	14	43
90	5,645	15,778	5,251	14,578	358	1,101	2	11	4	1	15	50	5	5	10	32
91	4,093	12,535	3,851	11,616	220	839	0	2	0	1	14	41	2	5	6	31
92	3,143	10,487	2,947	9,760	179	658	1	2	1	2	10	39	0	11	5	15
93	2,247	8,186	2,106	7,531	129	599	0	1	0	0	8	33	1	3	3	19
94	1,525	6,262	1,426	5,761	85	442	1	4	0	1	11	34	0	5	2	15
95	1,218	4,972	1,135	4,565	74	374	0	6	2	1	4	13	0	6	3	7
96	775	3,473	713	3,159	54	291	0	3	0	0	5	12	0	1	3	7
97	469	2,316	444	2,087	22	212	0	0	0	1	1	11	0	0	2	5
98	288	1,517	268	1,360	17	135	0	1	0	3	0	9	0	2	3	7

For each of the fourteen subgroups, a mathematical model is fitted to the body weight-age (Figure A1), height-age (Figure A2) and surface area-age (Figure A3) data:

$$y = a\left(c_1 - (c_1 - 1)e^{-\left(\frac{x}{b_1}\right)^{d_1}}\right)\left(c_2 - (c_2 - 1)e^{-\left(\frac{x}{b_2}\right)^{d_2}}\right)$$

Where y is body weight, height or surface area and x is age. The parameters a, b_1, b_2, c_1, c_2, d_1 and d_2 are optimized for each sex and ethnic group. The model is fitted using the PROAST software (PROAST version 38.9) and has sufficient flexibility to describe the varying growth spurts during different (early) life stages. In addition, the residual variance is estimated. The anthropomorphic data is assumed to be distributed log-normally.

For each age (1 to 70) (and sex), anthropometric data are simulated taking into account the number of individuals from the particular ethnic groups. For example, for age 10, 80,496 Dutch, 3,571 Turkish, 3,535 Moroccan, etc., boys are simulated and pooled into one dataset for 10-year-old boys. Anthropometric data are simulated by random drawing from a log-normal distribution with the age, sex and ethnicity-specific geometric mean (GM) and sex and ethnicity-specific geometric standard deviation (GSD). GM equals y from the mathematical model and geometric standard deviation (GSD) is derived from the residual variance.

Age and sex-specific results are reported in Table A3, A4 and A5 for body weight, length and surface area. Percentiles, GMs, GSDs and CVs are given. Percentiles are derived from the raw (simulated) data without assuming a distribution. GM and GSD are the back-transformed mean and SD of the log transformed raw (simulated) data. CV is derived using the following equation:

$$CV = \sqrt{e^{s^2} - 1}$$

Where s^2 is the variance of the log body weight, height or surface area

Visual inspection of the qq-plots of the raw (simulated) data (not shown) for each age showed that, although data from various ethnicity-specific groups are pooled, the overall distribution is log-normal.

Text continues after Table A5b.

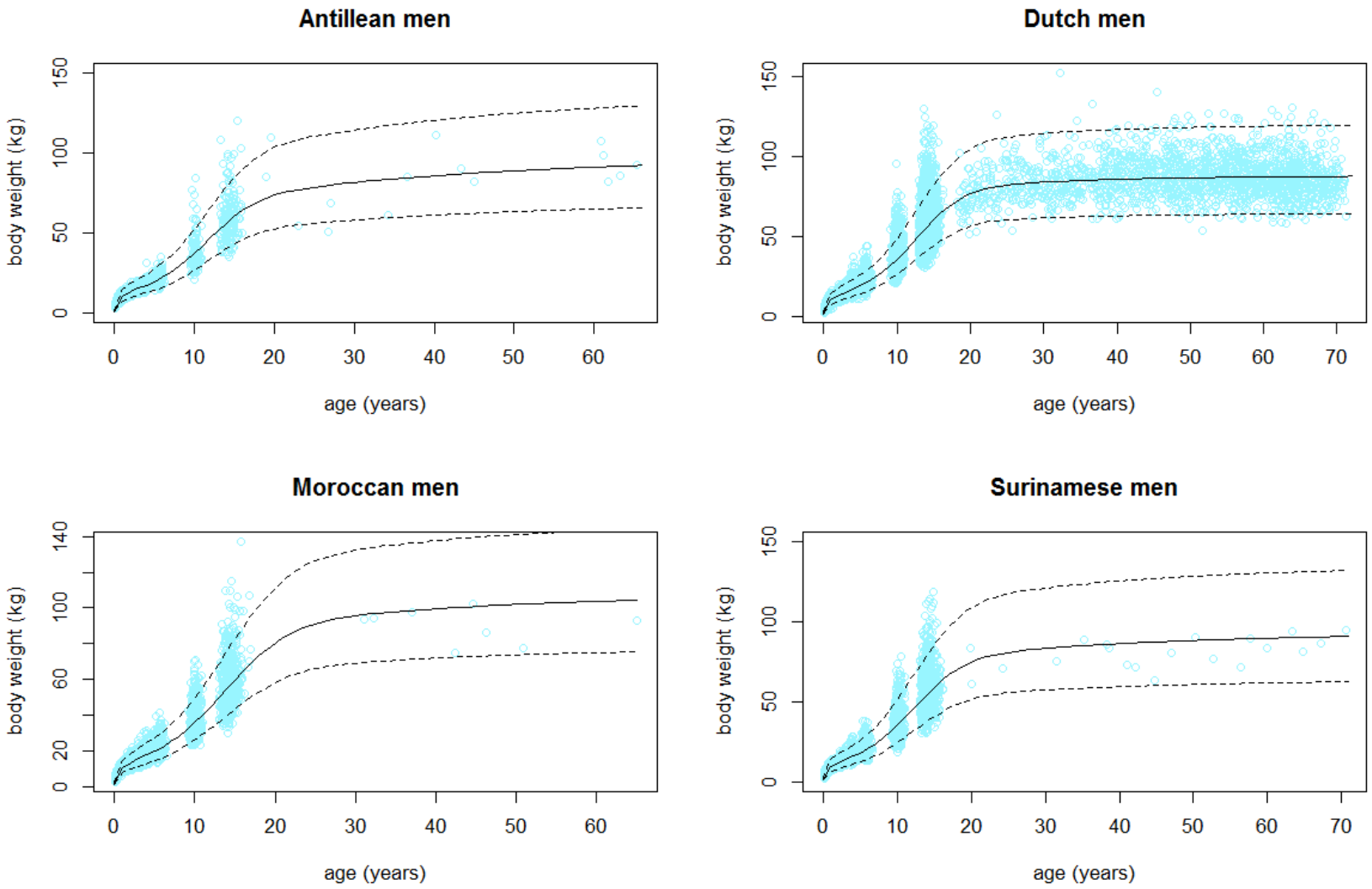
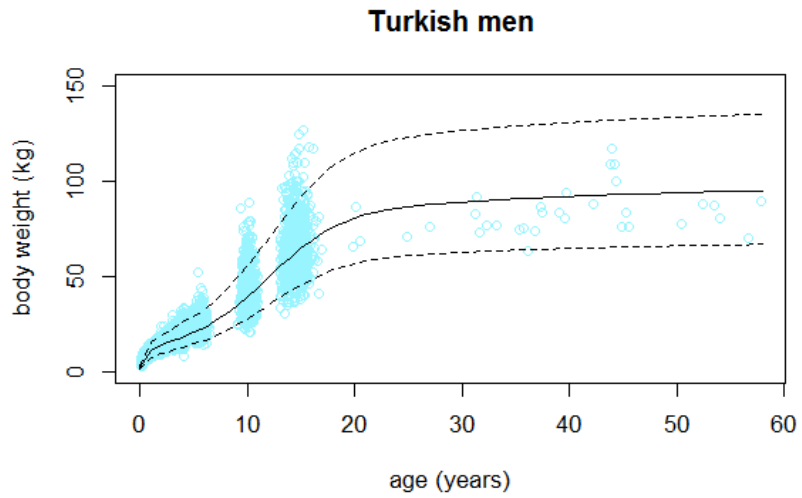
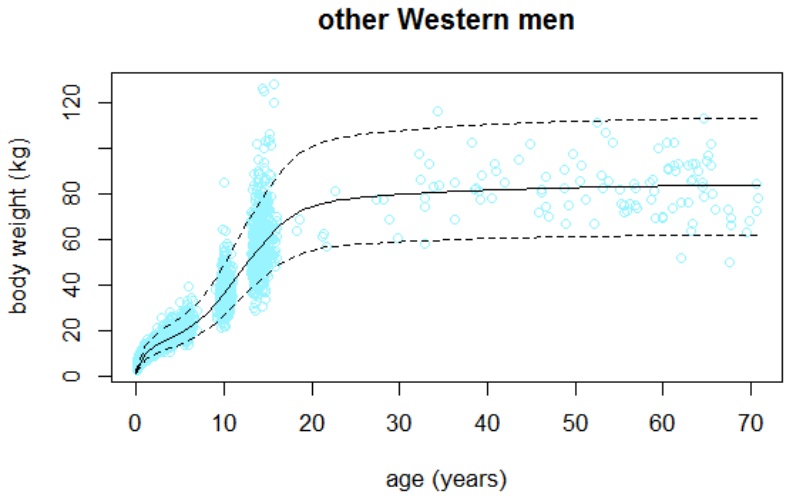


Figure A1: Individual body weight data and fitted function (solid line) of Antillean, Dutch, Moroccan and Surinamese men. Dashed lines are 1st and 99th percentile according to model and its residual variance.





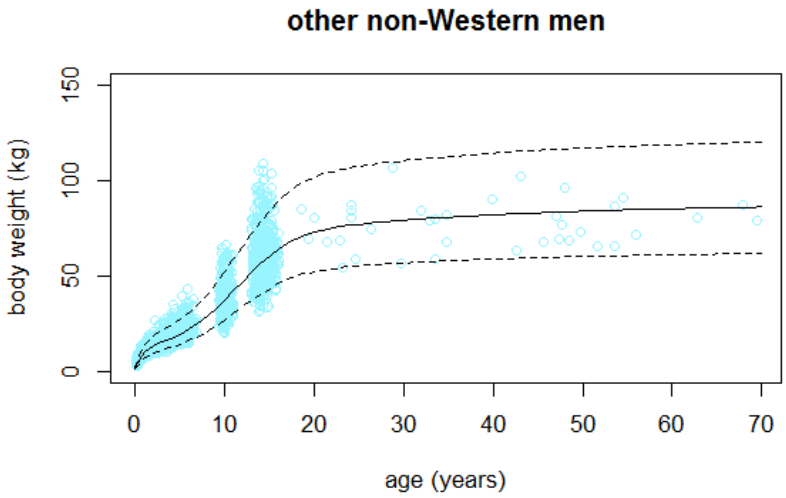


Figure A1 continued: Individual body weight data and fitted function (solid line) of Turkish, other Western, and other non-Western men. Dashed lines are 1st and 99th percentile according to model and its residual variance.

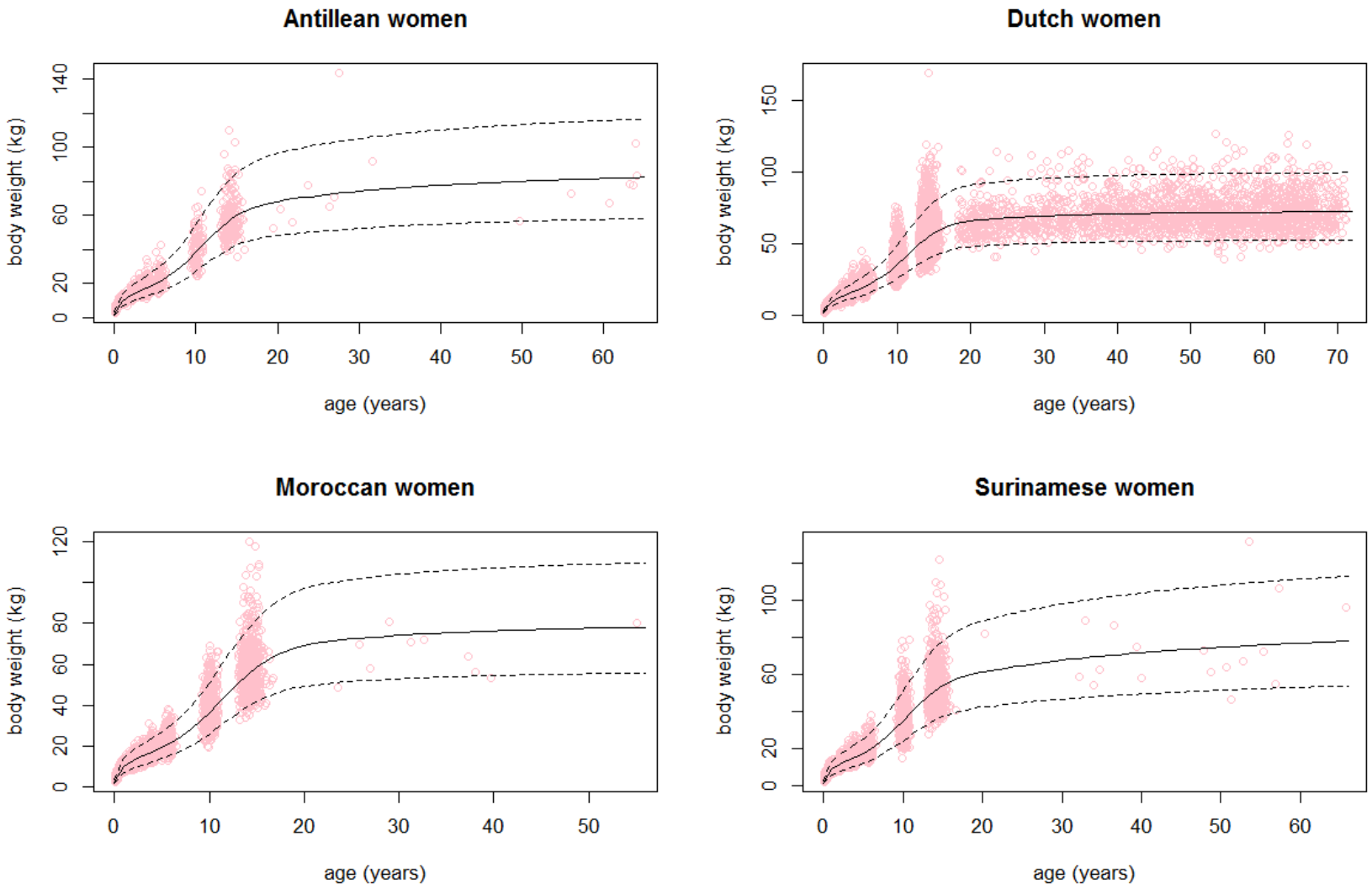
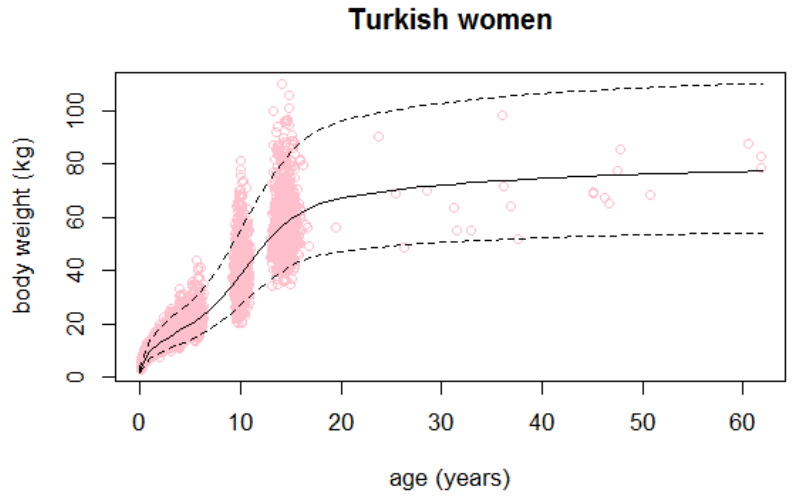
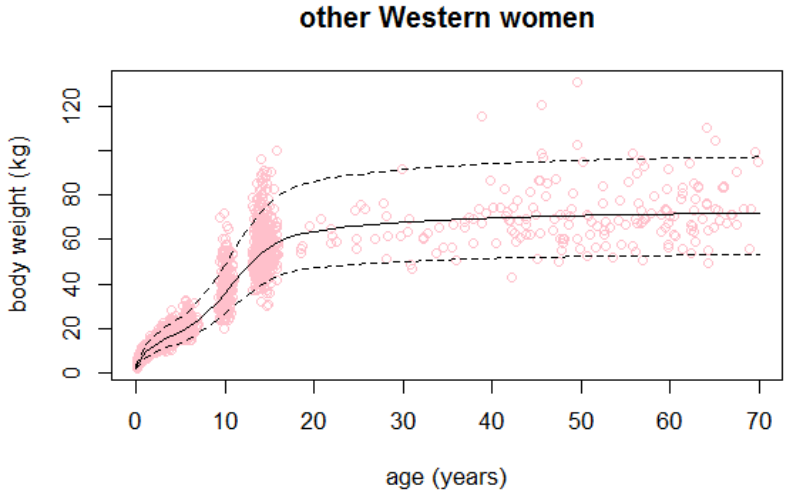


Figure A1 continued: Individual body weight data and fitted function (solid line) of Antillean, Dutch, Moroccan and Surinamese women. Dashed lines are 1st and 99th percentile according to model and its residual variance.





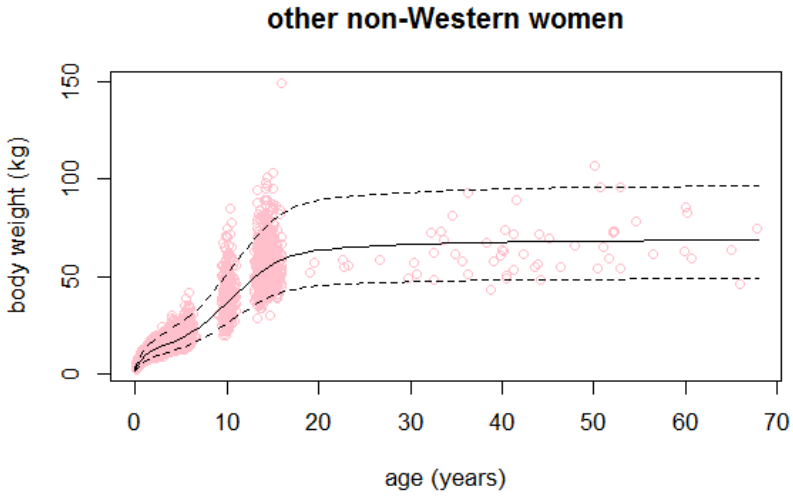


Figure A1 continued: Individual body weight data and fitted function (solid line) of Turkish, other Western and other non-Western women. Dashed lines are 1st and 99th percentile according to model and its residual variance.

Table A3a: Summary statistics for body weight (kg) of men

age	P05	P25	P50	P75	P95	GM	GSD	CV
1	8.1	9.3	10.2	11.1	12.7	10.2	1.15	0.14
2	10.5	11.9	13.1	14.3	16.3	13.1	1.15	0.14
3	12.1	13.9	15.2	16.6	19.0	15.2	1.15	0.14
4	13.7	15.6	17.1	18.8	21.5	17.1	1.15	0.14
5	15.3	17.5	19.2	21	24.0	19.2	1.15	0.14
6	17.3	19.7	21.6	23.7	27.0	21.6	1.15	0.14
7	19.5	22.3	24.4	26.8	30.6	24.4	1.15	0.14
8	22.2	25.3	27.8	30.5	34.9	27.8	1.15	0.14
9	25.3	28.9	31.7	34.7	39.7	31.7	1.15	0.14
10	28.8	32.8	36.0	39.4	45.1	36.0	1.15	0.14
11	32.5	37.1	40.7	44.6	51.1	40.7	1.15	0.14
12	36.6	41.7	45.7	50.1	57.4	45.7	1.15	0.14
13	40.7	46.3	50.8	55.7	63.7	50.8	1.15	0.14
14	44.6	51.0	55.8	61.2	69.7	55.8	1.15	0.14
15	48.5	55.3	60.6	66.3	75.8	60.6	1.15	0.14
16	51.9	59.2	64.9	71.1	81.1	64.9	1.15	0.14
17	54.9	62.7	68.7	75.2	85.9	68.7	1.15	0.14
18	57.6	65.7	71.9	78.9	89.9	71.9	1.15	0.14
19	59.5	68.1	74.6	81.7	93.1	74.6	1.15	0.14
20	61.3	70.0	76.7	84.1	96.0	76.7	1.15	0.14
21	62.5	71.5	78.4	86.0	98.2	78.4	1.15	0.14
22	63.5	72.6	79.6	87.4	99.9	79.7	1.15	0.14
23	64.3	73.4	80.5	88.4	100.9	80.6	1.15	0.14
24	64.8	74.0	81.3	89.2	102.2	81.3	1.15	0.14
25	65.1	74.4	81.7	89.8	103.0	81.8	1.15	0.14
26	65.5	75.0	82.2	90.3	103.4	82.3	1.15	0.14
27	65.9	75.4	82.7	90.8	104.2	82.8	1.15	0.14
28	66.1	75.6	83.1	91.3	104.5	83.1	1.15	0.14
29	66.6	76.0	83.4	91.6	105.0	83.5	1.15	0.14
30	66.7	76.3	83.8	92.0	105.6	83.8	1.15	0.14
31	66.9	76.5	84.0	92.2	105.7	84.0	1.15	0.14
32	67.2	76.8	84.3	92.7	106.2	84.4	1.15	0.14
33	67.5	76.9	84.5	92.7	106.3	84.5	1.15	0.14
34	67.6	77.2	84.7	93.1	106.8	84.8	1.15	0.14
35	67.8	77.4	85.0	93.3	107.1	85.0	1.15	0.14
36	67.9	77.6	85.2	93.6	107.3	85.2	1.15	0.14
37	68.0	77.8	85.3	93.6	107.3	85.4	1.15	0.14
38	68.2	77.9	85.5	93.9	107.7	85.6	1.15	0.14
39	68.3	78.1	85.6	94.1	107.9	85.7	1.15	0.14
40	68.5	78.2	85.8	94.1	107.8	85.8	1.15	0.14
41	68.5	78.3	85.9	94.2	107.9	85.9	1.15	0.14
42	68.7	78.3	85.8	94.3	107.9	86.0	1.15	0.14
43	68.8	78.6	86.2	94.6	108.4	86.3	1.15	0.14
44	68.9	78.7	86.2	94.7	108.3	86.3	1.15	0.14
45	69.0	78.8	86.3	94.7	108.8	86.4	1.15	0.14
46	69.1	78.9	86.5	94.9	108.6	86.6	1.15	0.14
47	69.2	79.0	86.6	94.9	108.8	86.6	1.15	0.14

age	P05	P25	P50	P75	P95	GM	GSD	CV
48	69.2	79.0	86.5	94.9	108.6	86.6	1.15	0.14
49	69.3	79.1	86.7	95.1	108.9	86.8	1.15	0.14
50	69.4	79.1	86.7	95.0	108.7	86.7	1.15	0.14
51	69.5	79.2	86.7	95.1	108.7	86.8	1.15	0.14
52	69.6	79.2	86.7	95.2	108.6	86.8	1.15	0.14
53	69.6	79.3	86.9	95.2	108.9	86.9	1.15	0.14
54	69.6	79.4	86.9	95.3	108.9	87.0	1.15	0.14
55	69.6	79.4	87.0	95.3	108.8	87.0	1.15	0.14
56	69.7	79.5	87.1	95.4	108.8	87.1	1.15	0.14
57	69.7	79.5	87.1	95.5	108.9	87.2	1.15	0.14
58	69.7	79.5	87.1	95.4	109.1	87.1	1.15	0.14
59	69.8	79.5	87.1	95.5	109.2	87.2	1.15	0.14
60	70.0	79.6	87.2	95.5	109.1	87.2	1.15	0.14
61	69.9	79.7	87.2	95.5	109.4	87.3	1.15	0.14
62	70.0	79.7	87.4	95.7	109.3	87.4	1.15	0.14
63	70.0	79.8	87.4	95.7	109.3	87.4	1.14	0.14
64	70.0	79.7	87.4	95.8	109.5	87.5	1.15	0.14
65	70.0	79.8	87.4	95.8	109.5	87.5	1.15	0.14
66	70.3	80.0	87.6	96.0	109.7	87.7	1.15	0.14
67	70.1	80.0	87.6	96.1	110.0	87.7	1.15	0.14
68	70.4	80.0	87.6	96.1	109.9	87.8	1.15	0.14
69	70.3	80.0	87.6	96.1	110.3	87.8	1.15	0.14
70	70.3	80.0	87.7	96.1	109.9	87.7	1.15	0.14

Table A3b: Summary statistics for body weight (kg) of women

age	P05	P25	P50	P75	P95	GM	GSD	CV
1	7.6	8.7	9.5	10.4	12	9.5	1.15	0.14
2	9.9	11.4	12.5	13.7	15.7	12.5	1.15	0.14
3	11.7	13.4	14.7	16.2	18.5	14.7	1.15	0.14
4	13.3	15.2	16.7	18.4	21.0	16.7	1.15	0.14
5	15.0	17.2	18.9	20.7	23.7	18.9	1.15	0.14
6	16.9	19.4	21.3	23.4	26.8	21.3	1.15	0.14
7	19.2	22.0	24.2	26.6	30.5	24.2	1.15	0.14
8	22.0	25.2	27.6	30.4	34.8	27.6	1.15	0.14
9	25.2	28.8	31.6	34.7	39.8	31.6	1.15	0.14
10	28.6	32.8	36.0	39.6	45.4	36.1	1.15	0.14
11	32.4	37.1	40.7	44.8	51.3	40.7	1.15	0.14
12	36.1	41.3	45.4	49.9	57.1	45.4	1.15	0.14
13	39.7	45.4	49.9	54.8	62.7	49.9	1.15	0.14
14	42.9	49.1	54.0	59.3	67.9	54.0	1.15	0.14
15	45.6	52.3	57.4	63.0	72.2	57.4	1.15	0.14
16	47.7	54.7	60.1	66.0	75.6	60.1	1.15	0.14
17	49.5	56.7	62.2	68.4	78.2	62.2	1.15	0.14
18	50.7	58.1	63.8	70.2	80.4	63.8	1.15	0.14
19	51.7	59.1	65.0	71.3	81.7	64.9	1.15	0.14
20	52.2	59.8	65.7	72.1	82.7	65.7	1.15	0.14
21	52.8	60.4	66.3	72.9	83.6	66.3	1.15	0.14
22	53.1	60.8	66.9	73.5	84.2	66.9	1.15	0.14

age	P05	P25	P50	P75	P95	GM	GSD	CV
23	53.3	61.2	67.3	74	84.6	67.2	1.15	0.14
24	53.8	61.5	67.6	74.3	85.1	67.6	1.15	0.14
25	54.0	61.8	67.9	74.7	85.6	67.9	1.15	0.14
26	54.2	62.1	68.2	75.0	86.0	68.2	1.15	0.14
27	54.5	62.4	68.5	75.3	86.5	68.6	1.15	0.14
28	54.7	62.7	68.9	75.7	86.8	68.9	1.15	0.14
29	54.9	62.9	69.1	76.0	87.1	69.1	1.15	0.14
30	55.1	63.2	69.4	76.1	87.3	69.4	1.15	0.14
31	55.3	63.3	69.5	76.5	87.7	69.6	1.15	0.14
32	55.5	63.6	69.8	76.7	87.8	69.8	1.15	0.14
33	55.7	63.7	70.0	76.9	88.2	70.0	1.15	0.14
34	55.8	63.8	70.0	77.1	88.3	70.1	1.15	0.14
35	55.9	64.1	70.4	77.4	88.8	70.4	1.15	0.14
36	56.0	64.2	70.4	77.4	88.7	70.5	1.15	0.14
37	56.2	64.3	70.6	77.6	88.9	70.6	1.15	0.14
38	56.3	64.4	70.8	77.8	89.3	70.8	1.15	0.14
39	56.3	64.5	70.9	77.9	89.2	70.9	1.15	0.14
40	56.5	64.7	71.0	77.9	89.4	71.0	1.15	0.14
41	56.6	64.8	71.1	78.1	89.6	71.2	1.15	0.14
42	56.7	64.8	71.2	78.1	89.5	71.2	1.15	0.14
43	56.8	64.9	71.3	78.3	89.6	71.3	1.15	0.14
44	56.8	65.0	71.4	78.4	89.9	71.4	1.15	0.14
45	57.0	65.1	71.4	78.5	90.0	71.5	1.15	0.14
46	57.1	65.2	71.6	78.6	90.0	71.6	1.15	0.14
47	57.0	65.2	71.6	78.7	90.2	71.6	1.15	0.14
48	57.1	65.3	71.6	78.7	90.1	71.7	1.15	0.14
49	57.1	65.3	71.7	78.8	90.3	71.7	1.15	0.14
50	57.2	65.5	71.8	78.9	90.4	71.9	1.15	0.14
51	57.1	65.4	71.8	78.8	90.4	71.8	1.15	0.14
52	57.3	65.5	71.9	78.9	90.5	71.9	1.15	0.14
53	57.3	65.6	72.0	79.0	90.5	72.0	1.15	0.14
54	57.4	65.6	72.0	79.1	90.6	72.1	1.15	0.14
55	57.4	65.7	72.1	79.2	90.7	72.2	1.15	0.14
56	57.5	65.7	72.1	79.2	90.7	72.1	1.15	0.14
57	57.5	65.7	72.1	79.2	90.8	72.1	1.15	0.14
58	57.5	65.8	72.2	79.2	90.7	72.2	1.15	0.14
59	57.5	65.8	72.1	79.2	90.7	72.2	1.15	0.14
60	57.6	65.9	72.3	79.3	90.8	72.3	1.15	0.14
61	57.6	65.9	72.3	79.4	90.8	72.3	1.15	0.14
62	57.8	65.9	72.2	79.2	90.9	72.3	1.15	0.14
63	57.7	65.9	72.3	79.3	90.8	72.3	1.15	0.14
64	57.7	66.0	72.4	79.5	91.0	72.4	1.15	0.14
65	57.8	66.0	72.4	79.4	90.7	72.4	1.15	0.14
66	57.9	66.0	72.4	79.4	90.7	72.4	1.15	0.14
67	57.8	66.1	72.5	79.5	91.0	72.5	1.15	0.14
68	57.9	66.1	72.4	79.5	91.1	72.5	1.15	0.14
69	57.9	66.0	72.4	79.5	91.0	72.5	1.15	0.14
70	57.8	66.0	72.4	79.5	90.9	72.5	1.15	0.14

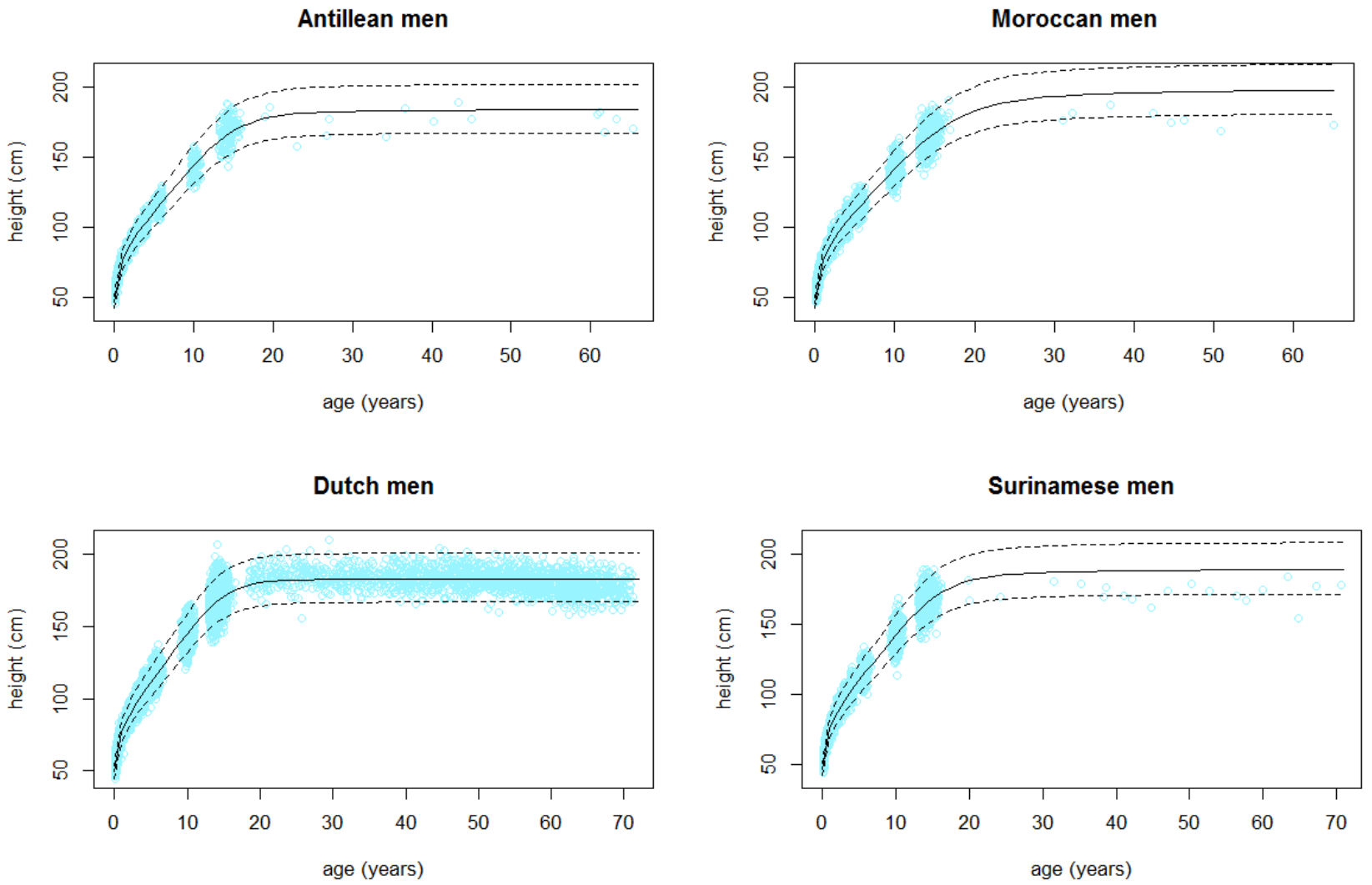


Figure A2: Individual body height data and fitted function (solid line) of Antillean, Dutch, Moroccan and Surinamese men. Dashed lines are 1st and 99th percentile according to model and its residual variance.

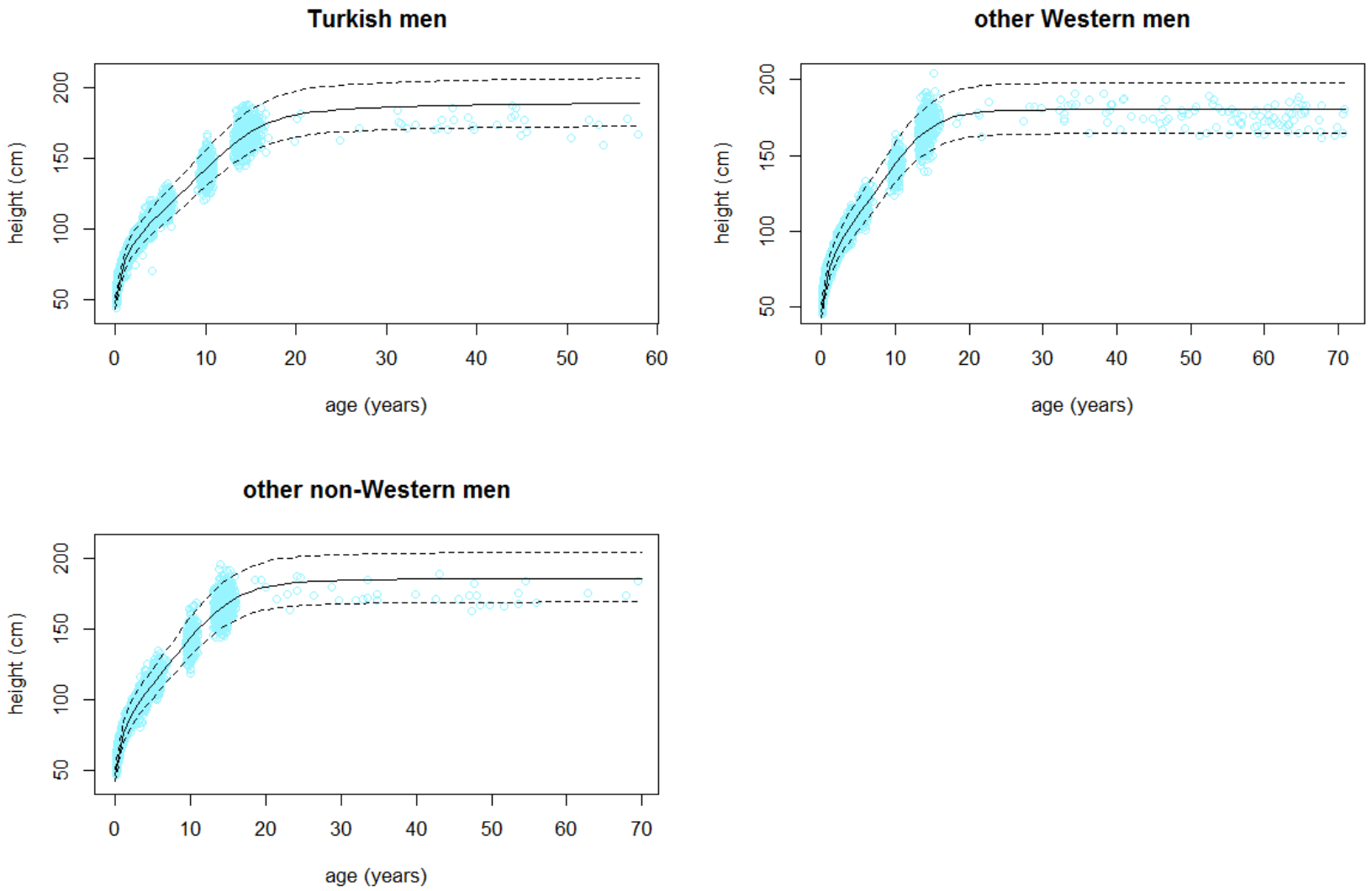


Figure A2 continued: Individual body height data and fitted function (solid line) of Turkish, other Western and other non-Western men. Dashed lines are 1st and 99th percentile according to model and its residual variance.

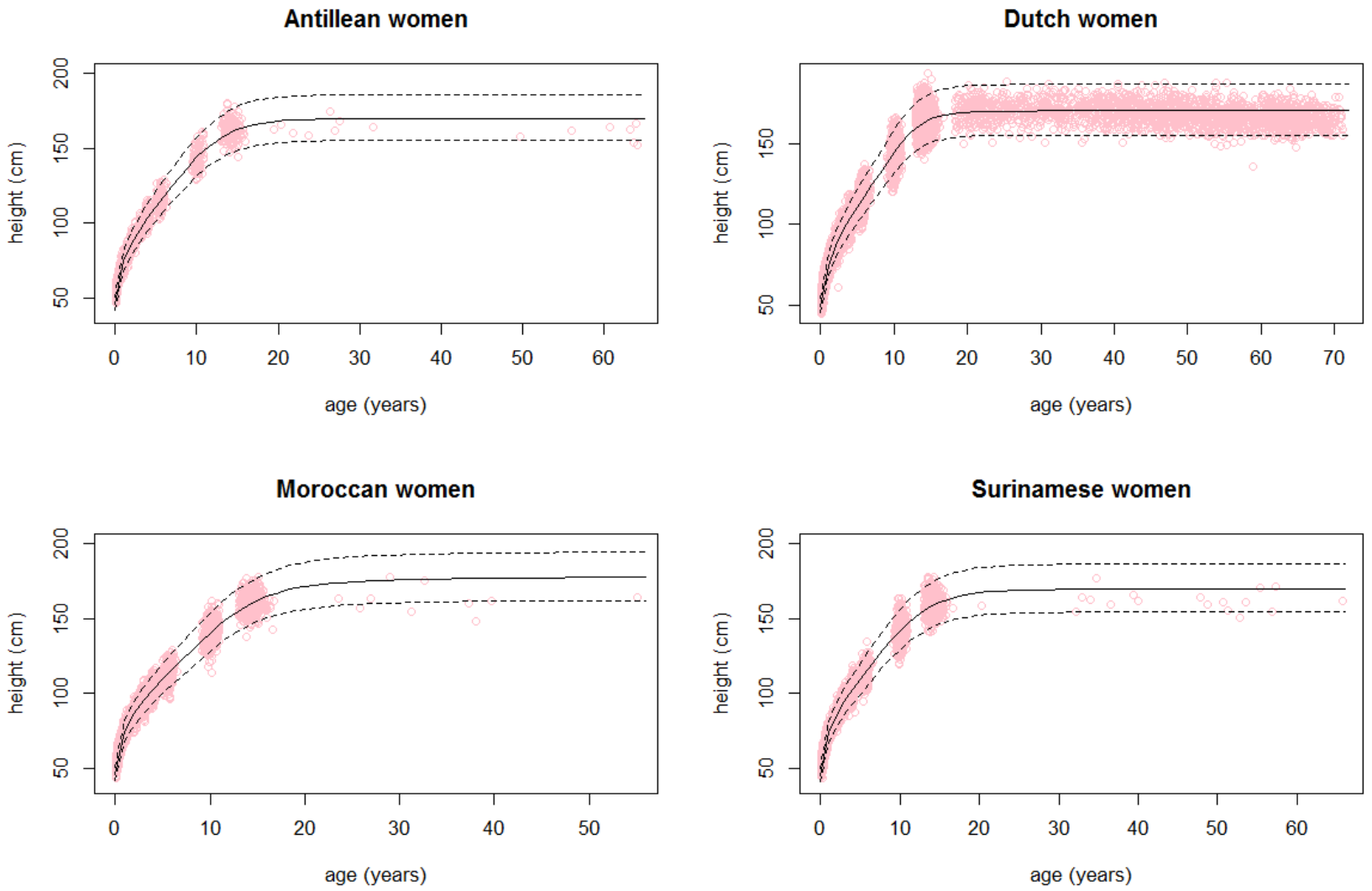
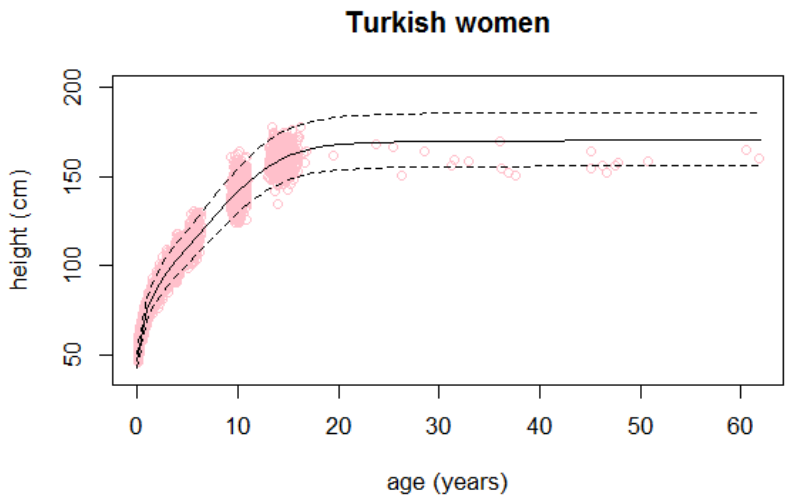
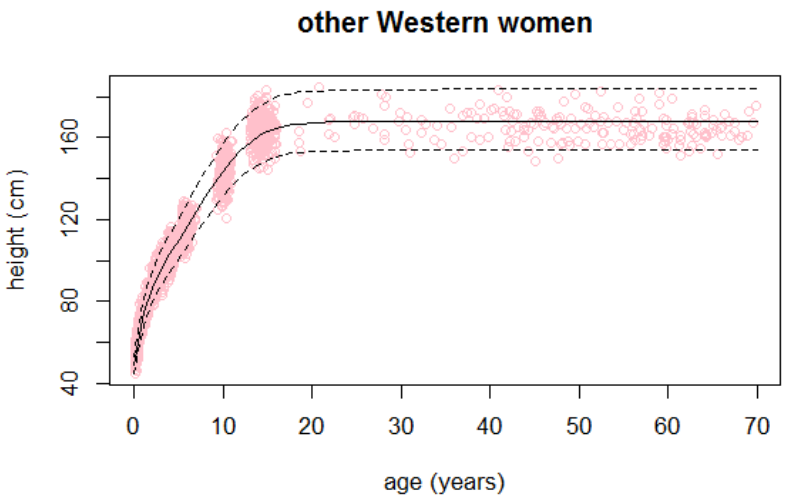


Figure A2 continued: Individual body height data and fitted function (solid line) of Antillean, Dutch, Moroccan and Surinamese women. Dashed lines are 1st and 99th percentile according to model and its residual variance.





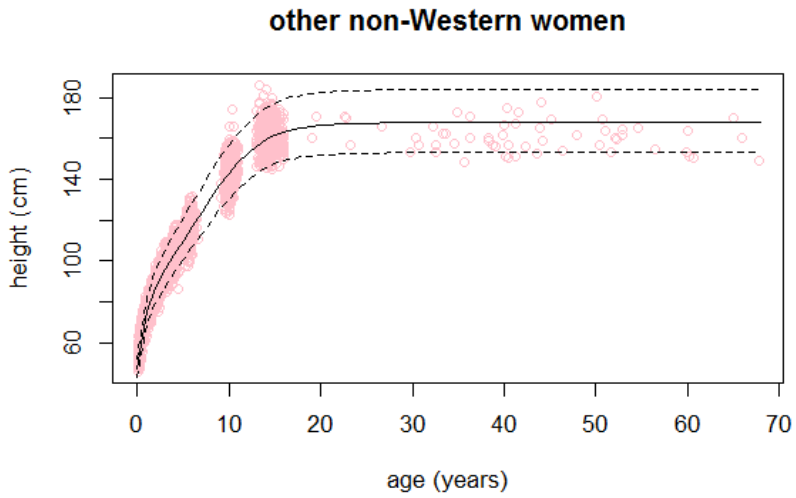


Figure A2 continued: Individual body height data and fitted function (solid line) of Turkish, other Western and other non-Western women. Dashed lines are 1st and 99th percentile according to model and its residual variance.

Table A4a: Summary statistics for height (cm) of men

Age	P05	P25	P50	P75	P95	GM	GSD	CV
1	71.6	74.4	76.4	78.5	81.6	76.4	1.04	0.040
2	83	86.2	88.6	91	94.6	88.6	1.04	0.040
3	91.1	94.7	97.2	99.9	103.8	97.3	1.04	0.040
4	97.9	101.7	104.5	107.4	111.6	104.5	1.04	0.040
5	104.1	108.3	111.2	114.3	118.8	111.2	1.04	0.040
6	110.3	114.7	117.9	121.1	125.9	117.9	1.04	0.040
7	116.6	121.2	124.5	127.9	133	124.5	1.04	0.040
8	122.9	127.8	131.3	134.9	140.3	131.3	1.04	0.040
9	129.3	134.4	138.1	141.9	147.5	138.1	1.04	0.040
10	135.5	140.9	144.8	148.8	154.7	144.8	1.04	0.040
11	141.3	147	151.1	155.3	161.5	151.1	1.04	0.040
12	146.8	152.7	156.9	161.3	167.7	156.9	1.04	0.041
13	151.7	157.8	162.1	166.6	173.3	162.1	1.04	0.040
14	155.9	162.2	166.7	171.3	178.1	166.7	1.04	0.040
15	159.6	165.9	170.5	175.2	182.2	170.5	1.04	0.040
16	162.4	168.9	173.5	178.3	185.3	173.5	1.04	0.040
17	164.7	171.2	176	180.8	188	175.9	1.04	0.040
18	166.5	173.1	177.8	182.7	189.9	177.8	1.04	0.040
19	167.7	174.4	179.2	184	191.3	179.1	1.04	0.040
20	168.7	175.4	180.2	185.1	192.4	180.2	1.04	0.040
21	169.3	176.1	180.9	185.9	193.2	180.9	1.04	0.040
22	169.8	176.6	181.5	186.5	193.9	181.5	1.04	0.040
23	170.1	176.9	181.9	186.9	194.4	181.9	1.04	0.041
24	170.4	177.2	182.2	187.2	194.8	182.2	1.04	0.041
25	170.5	177.5	182.4	187.5	195.2	182.4	1.04	0.041
26	170.8	177.7	182.6	187.7	195.5	182.7	1.04	0.041
27	170.9	177.8	182.7	187.9	195.6	182.8	1.04	0.041
28	171.1	177.9	182.9	188	195.8	182.9	1.04	0.041
29	171	178	183	188.1	196	183	1.04	0.041
30	171.3	178.1	183.1	188.2	196.1	183.1	1.04	0.042
31	171.2	178.1	183.1	188.3	196.3	183.2	1.04	0.042
32	171.3	178.2	183.2	188.5	196.5	183.3	1.04	0.042
33	171.4	178.3	183.3	188.4	196.4	183.3	1.04	0.042
34	171.3	178.3	183.3	188.5	196.6	183.4	1.04	0.042
35	171.5	178.4	183.4	188.6	196.7	183.5	1.04	0.042
36	171.5	178.4	183.4	188.7	196.7	183.5	1.04	0.042
37	171.5	178.4	183.4	188.6	196.7	183.5	1.04	0.042
38	171.4	178.4	183.4	188.7	196.7	183.5	1.04	0.042
39	171.6	178.5	183.5	188.6	196.8	183.6	1.04	0.042
40	171.5	178.5	183.5	188.6	196.7	183.5	1.04	0.042
41	171.6	178.4	183.4	188.6	196.7	183.5	1.04	0.042
42	171.5	178.4	183.4	188.7	196.7	183.5	1.04	0.042
43	171.7	178.5	183.5	188.7	196.9	183.6	1.04	0.042
44	171.6	178.5	183.5	188.7	196.7	183.6	1.04	0.042
45	171.6	178.5	183.5	188.7	196.8	183.6	1.04	0.042
46	171.7	178.5	183.5	188.7	196.7	183.6	1.04	0.042
47	171.6	178.5	183.5	188.7	196.6	183.6	1.04	0.041

Age	P05	P25	P50	P75	P95	GM	GSD	CV
48	171.6	178.5	183.5	188.7	196.5	183.6	1.04	0.042
49	171.6	178.5	183.5	188.7	196.6	183.5	1.04	0.041
50	171.6	178.5	183.5	188.6	196.5	183.5	1.04	0.041
51	171.6	178.5	183.4	188.6	196.4	183.5	1.04	0.041
52	171.6	178.5	183.4	188.5	196.3	183.4	1.04	0.041
53	171.7	178.5	183.5	188.6	196.5	183.5	1.04	0.041
54	171.6	178.5	183.4	188.5	196.2	183.5	1.04	0.041
55	171.5	178.4	183.4	188.5	196.2	183.4	1.04	0.041
56	171.5	178.4	183.3	188.5	196.1	183.4	1.04	0.041
57	171.6	178.4	183.4	188.5	196.2	183.4	1.04	0.041
58	171.4	178.3	183.3	188.3	196.1	183.3	1.04	0.041
59	171.5	178.4	183.3	188.4	196.2	183.4	1.04	0.041
60	171.5	178.3	183.3	188.4	196.1	183.3	1.04	0.041
61	171.5	178.4	183.3	188.4	196.2	183.3	1.04	0.041
62	171.5	178.4	183.3	188.4	196.1	183.3	1.04	0.041
63	171.5	178.4	183.3	188.4	196.2	183.3	1.04	0.041
64	171.5	178.4	183.4	188.5	196.3	183.4	1.04	0.041
65	171.5	178.4	183.3	188.5	196.3	183.4	1.04	0.041
66	171.6	178.4	183.3	188.4	196.3	183.4	1.04	0.041
67	171.5	178.4	183.4	188.5	196.5	183.5	1.04	0.041
68	171.5	178.4	183.3	188.5	196.2	183.4	1.04	0.041
69	171.5	178.4	183.4	188.6	196.7	183.5	1.04	0.042
70	171.6	178.3	183.3	188.4	196.2	183.4	1.04	0.041

Table A4b: Summary statistics for height (cm) of women

age	P05	P25	P50	P75	P95	GM	GSD	CV
1	70	72.7	74.7	76.7	79.7	74.7	1.04	0.039
2	81.7	84.9	87.2	89.5	93	87.2	1.04	0.039
3	90	93.6	96.1	98.7	102.6	96.1	1.04	0.040
4	97.1	100.9	103.6	106.4	110.6	103.6	1.04	0.040
5	103.6	107.7	110.6	113.6	117.9	110.6	1.04	0.039
6	110.1	114.4	117.5	120.6	125.3	117.5	1.04	0.040
7	116.5	121.1	124.4	127.7	132.7	124.4	1.04	0.040
8	122.9	127.8	131.3	134.8	140.2	131.3	1.04	0.040
9	129.2	134.3	138	141.8	147.5	138	1.04	0.040
10	135.1	140.5	144.3	148.3	154.1	144.3	1.04	0.040
11	140.3	146	150	154.2	160.3	150	1.04	0.040
12	144.9	150.8	154.9	159.2	165.5	154.9	1.04	0.041
13	148.6	154.6	158.9	163.3	169.8	158.9	1.04	0.041
14	151.7	157.7	162.1	166.6	173.2	162.1	1.04	0.040
15	154	160.1	164.5	169	175.9	164.5	1.04	0.040
16	155.7	161.8	166.2	170.8	177.6	166.2	1.04	0.040
17	156.8	163	167.5	172	178.8	167.4	1.04	0.040
18	157.5	163.8	168.3	172.9	179.8	168.3	1.04	0.040
19	158.1	164.3	168.8	173.4	180.3	168.8	1.04	0.040
20	158.3	164.6	169.1	173.7	180.6	169.1	1.04	0.040
21	158.6	164.8	169.4	174	180.9	169.4	1.04	0.040
22	158.7	165	169.5	174.2	181	169.5	1.04	0.040

age	P05	P25	P50	P75	P95	GM	GSD	CV
23	158.8	165.1	169.7	174.3	181.2	169.6	1.04	0.040
24	158.9	165.2	169.7	174.4	181.3	169.7	1.04	0.040
25	159	165.2	169.8	174.4	181.4	169.8	1.04	0.040
26	159	165.3	169.8	174.5	181.5	169.9	1.04	0.040
27	159.1	165.4	169.9	174.6	181.6	169.9	1.04	0.040
28	159.2	165.5	170	174.6	181.7	170	1.04	0.040
29	159.2	165.5	170	174.7	181.7	170	1.04	0.040
30	159.2	165.5	170	174.7	181.8	170	1.04	0.040
31	159.2	165.5	170	174.7	181.7	170.1	1.04	0.040
32	159.3	165.6	170.1	174.8	181.8	170.1	1.04	0.040
33	159.2	165.5	170.1	174.8	181.8	170.1	1.04	0.040
34	159.3	165.6	170.1	174.8	181.8	170.1	1.04	0.040
35	159.4	165.6	170.1	174.8	181.8	170.2	1.04	0.040
36	159.3	165.6	170.1	174.8	181.8	170.1	1.04	0.040
37	159.3	165.6	170.1	174.8	181.9	170.2	1.04	0.040
38	159.4	165.6	170.2	174.9	182	170.2	1.04	0.040
39	159.4	165.6	170.2	174.9	181.8	170.2	1.04	0.040
40	159.3	165.7	170.2	174.9	181.8	170.2	1.04	0.040
41	159.4	165.7	170.2	174.8	181.8	170.2	1.04	0.040
42	159.4	165.6	170.1	174.8	181.8	170.2	1.04	0.040
43	159.4	165.6	170.2	174.9	181.8	170.2	1.04	0.040
44	159.4	165.7	170.2	174.8	181.9	170.2	1.04	0.040
45	159.4	165.7	170.2	174.9	181.8	170.2	1.04	0.040
46	159.5	165.7	170.2	174.8	181.7	170.2	1.04	0.040
47	159.4	165.7	170.2	174.8	181.9	170.2	1.04	0.040
48	159.4	165.7	170.2	174.9	181.9	170.2	1.04	0.040
49	159.4	165.7	170.2	174.9	181.9	170.3	1.04	0.040
50	159.4	165.7	170.2	174.8	181.8	170.2	1.04	0.040
51	159.4	165.7	170.2	174.8	181.8	170.2	1.04	0.040
52	159.4	165.7	170.2	174.9	181.8	170.2	1.04	0.040
53	159.4	165.7	170.3	174.9	181.9	170.2	1.04	0.040
54	159.4	165.7	170.2	174.9	181.8	170.2	1.04	0.040
55	159.4	165.7	170.2	174.9	181.8	170.2	1.04	0.040
56	159.4	165.7	170.2	174.9	181.7	170.2	1.04	0.040
57	159.5	165.7	170.2	174.9	181.8	170.3	1.04	0.040
58	159.5	165.7	170.2	174.8	181.8	170.2	1.04	0.040
59	159.5	165.7	170.3	174.9	181.8	170.3	1.04	0.040
60	159.4	165.7	170.2	174.8	181.7	170.2	1.04	0.040
61	159.4	165.7	170.2	174.9	181.8	170.2	1.04	0.040
62	159.5	165.7	170.2	174.8	181.7	170.2	1.04	0.040
63	159.5	165.8	170.3	174.9	181.8	170.3	1.04	0.040
64	159.4	165.7	170.2	174.8	181.8	170.2	1.04	0.040
65	159.5	165.7	170.3	174.9	181.8	170.3	1.04	0.040
66	159.5	165.7	170.2	174.9	181.8	170.2	1.04	0.040
67	159.6	165.8	170.3	174.9	181.9	170.3	1.04	0.040
68	159.5	165.7	170.2	174.8	181.7	170.2	1.04	0.040
69	159.5	165.8	170.2	174.9	181.8	170.2	1.04	0.040
70	159.5	165.7	170.2	174.8	181.8	170.2	1.04	0.040

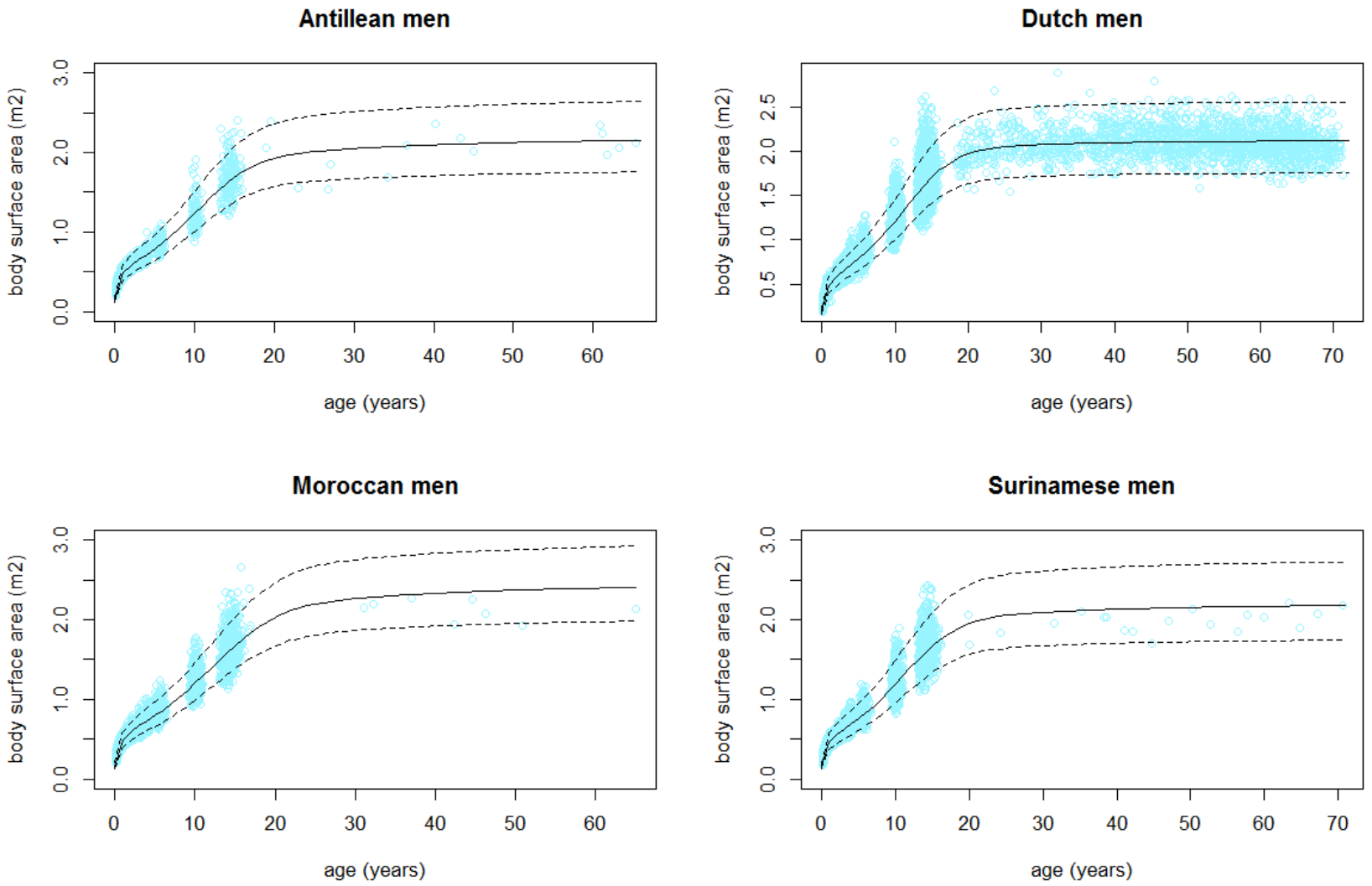


Figure A3: Individual body surface area data and fitted function (solid line) of Antillean, Dutch, Moroccan and Surinamese men. Dashed lines are 1st and 99th percentile according to model and its residual variance.

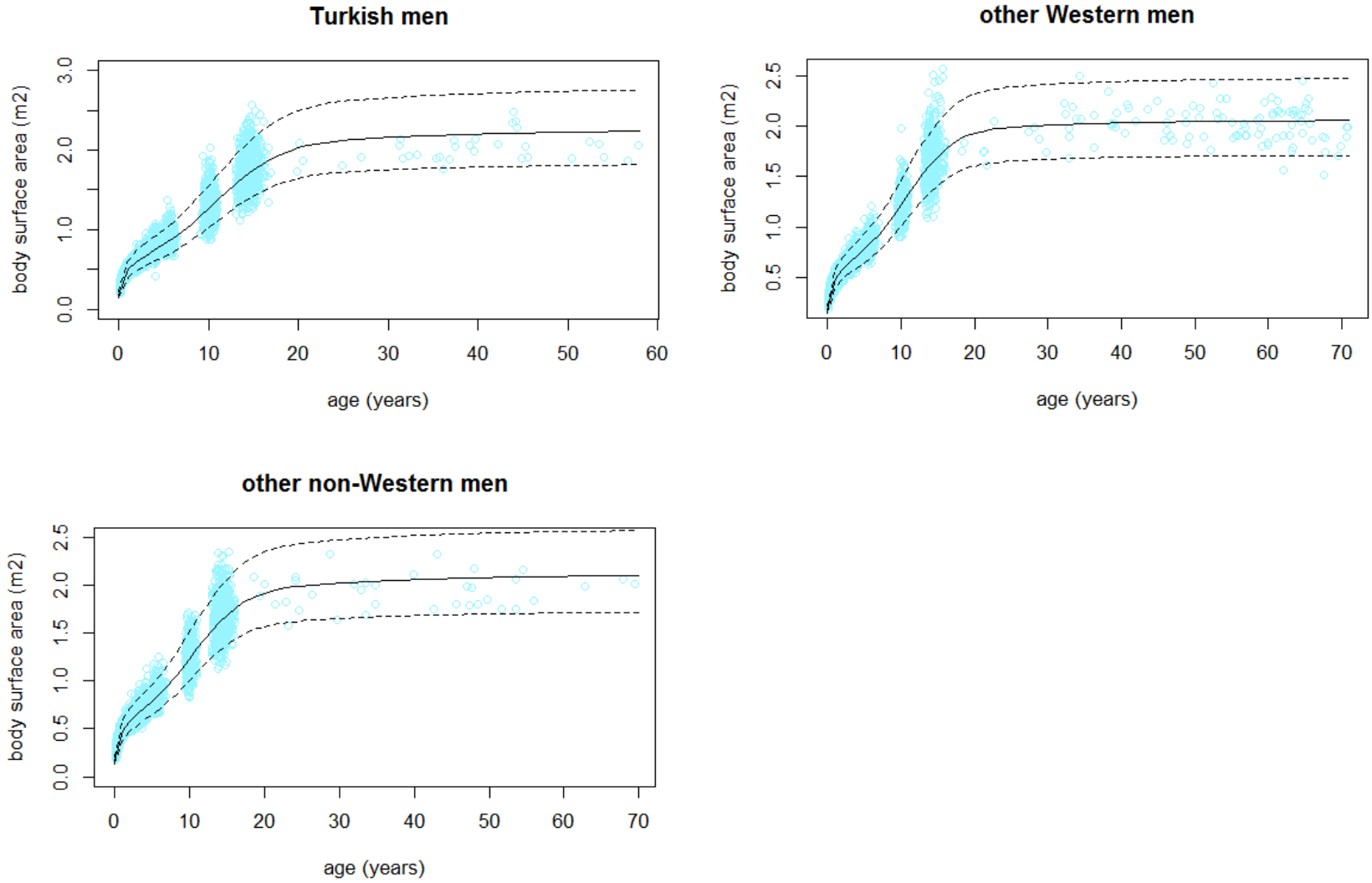


Figure A3 continued: Individual body surface area data and fitted function (solid line) of Turkish, other Western and other non-Western men. Dashed lines are 1st and 99th percentile according to model and its residual variance.

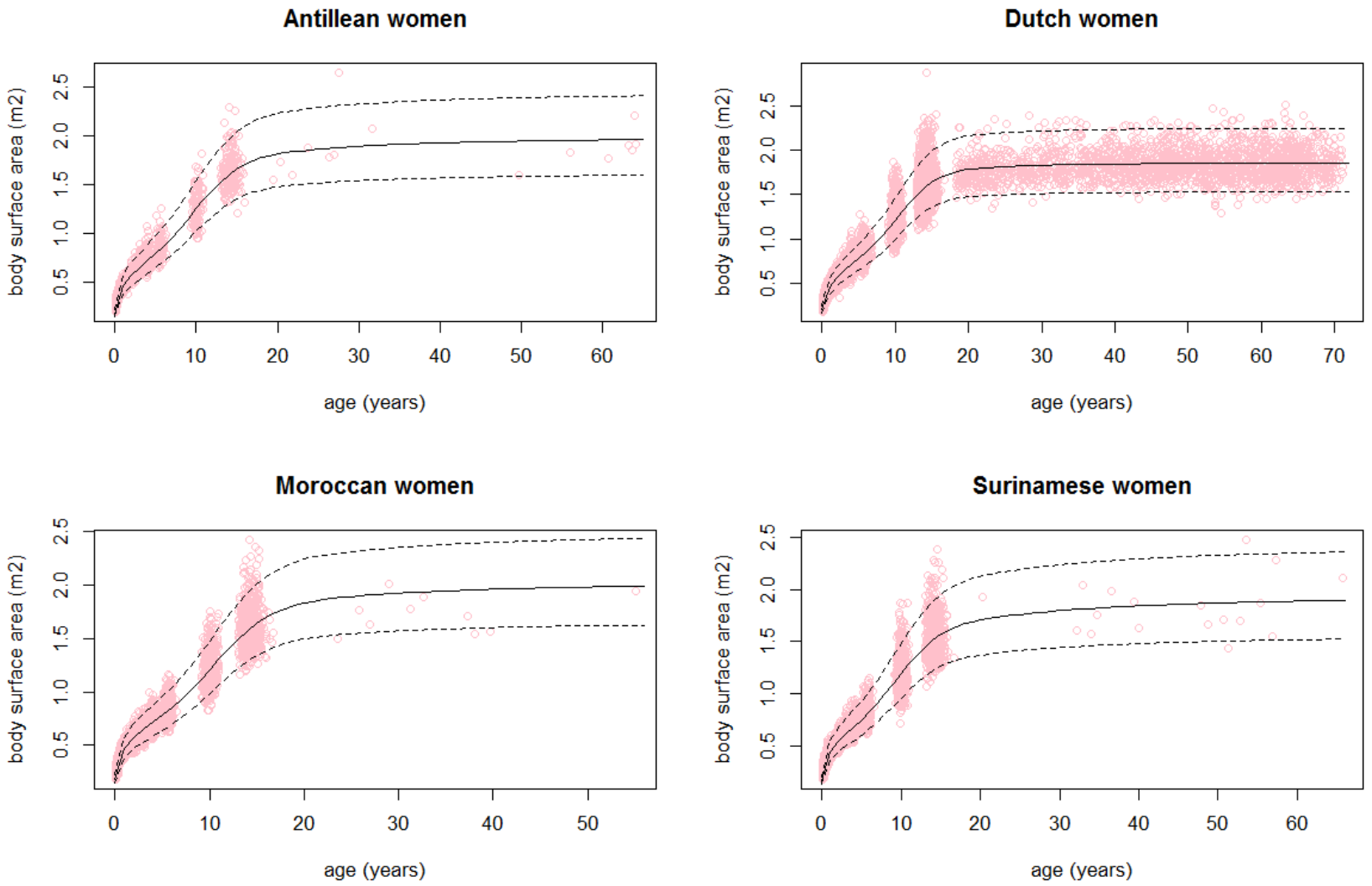
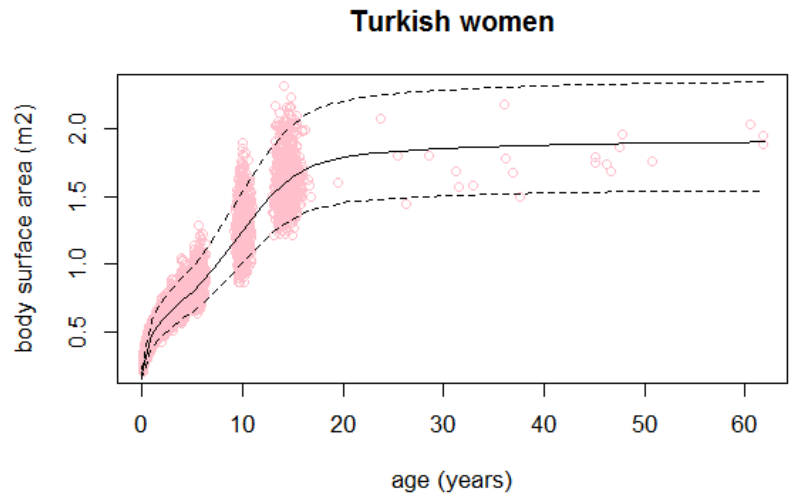
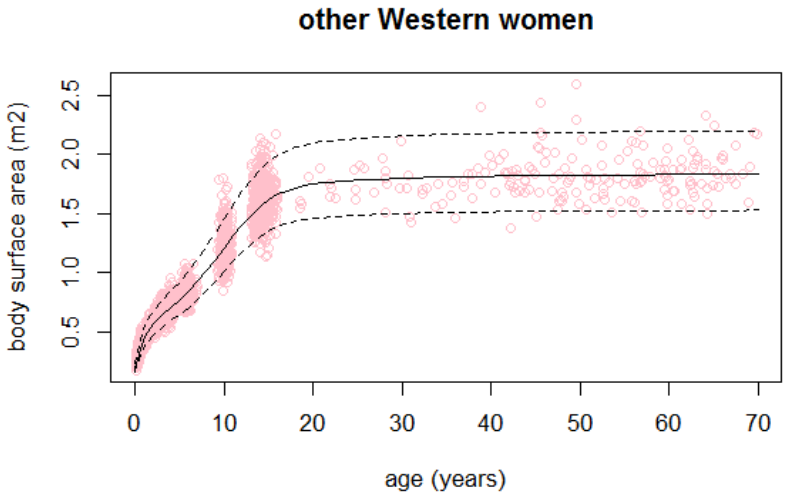


Figure A3 continued: Individual body surface area data and fitted function (solid line) of Antillean, Dutch, Moroccan and Surinamese women. Dashed lines are 1st and 99th percentile according to model and its residual variance.





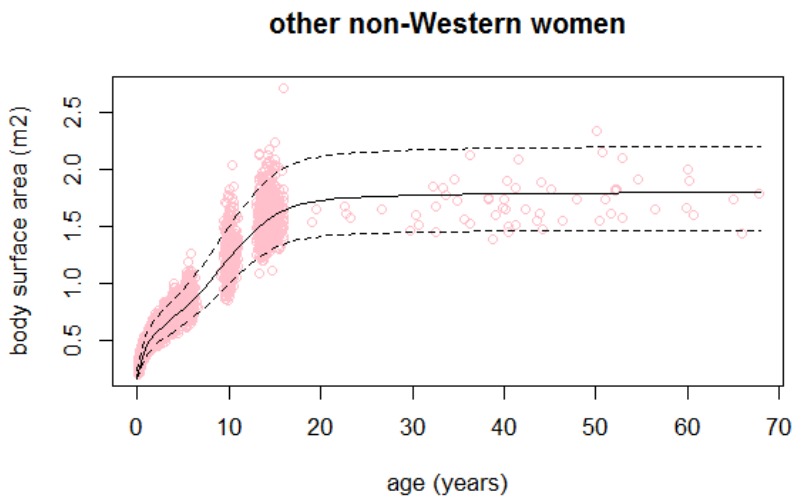


Figure A3 continued: Individual body surface area data and fitted function (solid line) of Turkish, other Western and other non-Western women. Dashed lines are 1st and 99th percentile according to model and its residual variance.

Table A5a: Summary statistics for surface area (m^2) of men

age	P05	P25	P50	P75	P95	GM	GSD	CV
1	0.42	0.46	0.49	0.51	0.56	0.48	1.09	0.083
2	0.51	0.55	0.59	0.62	0.67	0.59	1.09	0.083
3	0.57	0.62	0.66	0.70	0.75	0.66	1.09	0.083
4	0.63	0.68	0.72	0.76	0.83	0.72	1.09	0.083
5	0.69	0.74	0.79	0.83	0.90	0.79	1.09	0.083
6	0.75	0.81	0.86	0.91	0.98	0.86	1.09	0.083
7	0.82	0.88	0.94	0.99	1.07	0.93	1.09	0.083
8	0.89	0.97	1.02	1.08	1.17	1.02	1.09	0.083
9	0.97	1.05	1.11	1.18	1.28	1.11	1.09	0.083
10	1.06	1.15	1.22	1.28	1.39	1.22	1.09	0.083
11	1.15	1.25	1.32	1.39	1.51	1.32	1.09	0.083
12	1.24	1.35	1.42	1.50	1.63	1.42	1.09	0.083
13	1.33	1.44	1.52	1.61	1.74	1.52	1.09	0.083
14	1.41	1.53	1.62	1.71	1.85	1.62	1.09	0.083
15	1.49	1.61	1.70	1.80	1.95	1.70	1.09	0.083
16	1.55	1.68	1.78	1.88	2.04	1.78	1.09	0.082
17	1.61	1.74	1.84	1.95	2.11	1.84	1.09	0.082
18	1.65	1.79	1.89	2.00	2.17	1.89	1.09	0.083
19	1.69	1.83	1.94	2.05	2.22	1.94	1.09	0.083
20	1.72	1.86	1.97	2.08	2.26	1.97	1.09	0.083
21	1.74	1.89	2.00	2.11	2.29	2.00	1.09	0.083
22	1.75	1.90	2.01	2.13	2.31	2.01	1.09	0.084
23	1.77	1.92	2.03	2.15	2.33	2.03	1.09	0.084
24	1.78	1.93	2.04	2.16	2.34	2.04	1.09	0.084
25	1.78	1.94	2.05	2.17	2.35	2.05	1.09	0.084
26	1.79	1.94	2.05	2.17	2.36	2.05	1.09	0.085
27	1.79	1.94	2.06	2.18	2.37	2.06	1.09	0.085
28	1.80	1.95	2.06	2.19	2.38	2.07	1.09	0.085
29	1.80	1.95	2.07	2.19	2.38	2.07	1.09	0.085
30	1.81	1.96	2.07	2.19	2.39	2.07	1.09	0.085
31	1.81	1.96	2.08	2.20	2.39	2.08	1.09	0.085
32	1.81	1.97	2.08	2.20	2.40	2.08	1.09	0.085
33	1.81	1.97	2.08	2.20	2.40	2.08	1.09	0.085
34	1.82	1.97	2.08	2.21	2.40	2.09	1.09	0.085
35	1.82	1.97	2.09	2.21	2.41	2.09	1.09	0.085
36	1.82	1.98	2.09	2.21	2.41	2.09	1.09	0.085
37	1.82	1.98	2.09	2.22	2.41	2.09	1.09	0.085
38	1.83	1.98	2.10	2.22	2.41	2.10	1.09	0.085
39	1.83	1.98	2.10	2.22	2.41	2.10	1.09	0.085
40	1.83	1.98	2.10	2.22	2.41	2.10	1.09	0.085
41	1.83	1.98	2.10	2.22	2.42	2.10	1.09	0.085
42	1.83	1.99	2.10	2.22	2.42	2.10	1.09	0.085
43	1.83	1.99	2.10	2.23	2.42	2.10	1.09	0.085
44	1.84	1.99	2.10	2.23	2.42	2.11	1.09	0.084
45	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.084
46	1.84	1.99	2.10	2.23	2.42	2.11	1.09	0.084
47	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.084

age	P05	P25	P50	P75	P95	GM	GSD	CV
48	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.084
49	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.084
50	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.084
51	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.084
52	1.84	1.99	2.11	2.23	2.42	2.11	1.09	0.083
53	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
54	1.84	2.00	2.11	2.23	2.42	2.11	1.09	0.083
55	1.84	2.00	2.11	2.23	2.42	2.11	1.09	0.083
56	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
57	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
58	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
59	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
60	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
61	1.85	2.00	2.11	2.24	2.43	2.11	1.09	0.083
62	1.85	2.00	2.11	2.23	2.42	2.11	1.09	0.083
63	1.85	2.00	2.11	2.24	2.42	2.12	1.09	0.083
64	1.85	2.00	2.12	2.24	2.43	2.12	1.09	0.083
65	1.85	2.00	2.12	2.24	2.43	2.12	1.09	0.083
66	1.85	2.00	2.12	2.24	2.43	2.12	1.09	0.083
67	1.85	2.00	2.12	2.24	2.43	2.12	1.09	0.084
68	1.85	2.00	2.12	2.24	2.43	2.12	1.09	0.084
69	1.85	2.00	2.12	2.24	2.44	2.12	1.09	0.084
70	1.85	2.00	2.12	2.24	2.43	2.12	1.09	0.084

Table A5b: Summary statistics for surface area (m^2) of women

age	P05	P25	P50	P75	P95	GM	GSD	CV
1	0.40	0.44	0.46	0.49	0.53	0.46	1.09	0.084
2	0.50	0.54	0.57	0.60	0.65	0.57	1.09	0.084
3	0.56	0.61	0.64	0.68	0.74	0.64	1.09	0.084
4	0.62	0.67	0.71	0.75	0.82	0.71	1.09	0.084
5	0.68	0.74	0.78	0.82	0.89	0.78	1.09	0.084
6	0.74	0.80	0.85	0.90	0.98	0.85	1.09	0.084
7	0.81	0.88	0.93	0.98	1.07	0.93	1.09	0.084
8	0.89	0.96	1.02	1.08	1.17	1.02	1.09	0.084
9	0.97	1.05	1.11	1.18	1.28	1.11	1.09	0.084
10	1.06	1.15	1.21	1.28	1.39	1.21	1.09	0.084
11	1.15	1.24	1.31	1.39	1.51	1.31	1.09	0.084
12	1.23	1.33	1.41	1.49	1.62	1.41	1.09	0.084
13	1.30	1.41	1.50	1.58	1.71	1.50	1.09	0.084
14	1.37	1.49	1.57	1.66	1.80	1.57	1.09	0.084
15	1.42	1.54	1.63	1.73	1.87	1.63	1.09	0.084
16	1.47	1.59	1.68	1.78	1.93	1.68	1.09	0.084
17	1.50	1.63	1.72	1.82	1.97	1.72	1.09	0.084
18	1.52	1.65	1.75	1.85	2.00	1.75	1.09	0.084
19	1.54	1.67	1.76	1.87	2.03	1.76	1.09	0.084
20	1.55	1.68	1.78	1.88	2.04	1.78	1.09	0.085
21	1.56	1.69	1.79	1.89	2.05	1.79	1.09	0.084
22	1.56	1.70	1.79	1.90	2.06	1.79	1.09	0.084

age	P05	P25	P50	P75	P95	GM	GSD	CV
23	1.57	1.70	1.80	1.90	2.07	1.80	1.09	0.084
24	1.57	1.71	1.80	1.91	2.07	1.80	1.09	0.084
25	1.58	1.71	1.81	1.91	2.08	1.81	1.09	0.085
26	1.58	1.71	1.81	1.92	2.08	1.81	1.09	0.084
27	1.58	1.72	1.82	1.92	2.09	1.82	1.09	0.085
28	1.59	1.72	1.82	1.93	2.09	1.82	1.09	0.085
29	1.59	1.72	1.82	1.93	2.10	1.82	1.09	0.085
30	1.59	1.73	1.83	1.93	2.10	1.83	1.09	0.085
31	1.59	1.73	1.83	1.93	2.10	1.83	1.09	0.084
32	1.60	1.73	1.83	1.94	2.10	1.83	1.09	0.084
33	1.60	1.73	1.83	1.94	2.11	1.83	1.09	0.084
34	1.60	1.73	1.83	1.94	2.11	1.84	1.09	0.084
35	1.60	1.73	1.84	1.94	2.11	1.84	1.09	0.084
36	1.60	1.74	1.84	1.94	2.11	1.84	1.09	0.084
37	1.60	1.74	1.84	1.95	2.11	1.84	1.09	0.084
38	1.60	1.74	1.84	1.95	2.12	1.84	1.09	0.084
39	1.60	1.74	1.84	1.95	2.12	1.84	1.09	0.084
40	1.61	1.74	1.84	1.95	2.12	1.84	1.09	0.084
41	1.61	1.74	1.84	1.95	2.12	1.84	1.09	0.084
42	1.61	1.74	1.85	1.95	2.12	1.85	1.09	0.084
43	1.61	1.74	1.85	1.95	2.12	1.85	1.09	0.084
44	1.61	1.75	1.85	1.95	2.12	1.85	1.09	0.084
45	1.61	1.75	1.85	1.95	2.12	1.85	1.09	0.084
46	1.61	1.75	1.85	1.95	2.12	1.85	1.09	0.084
47	1.61	1.75	1.85	1.95	2.12	1.85	1.09	0.084
48	1.61	1.75	1.85	1.96	2.12	1.85	1.09	0.084
49	1.61	1.75	1.85	1.96	2.12	1.85	1.09	0.084
50	1.61	1.75	1.85	1.96	2.12	1.85	1.09	0.084
51	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
52	1.61	1.75	1.85	1.96	2.13	1.85	1.09	0.083
53	1.61	1.75	1.85	1.96	2.12	1.85	1.09	0.084
54	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.084
55	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
56	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
57	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
58	1.62	1.75	1.85	1.96	2.12	1.85	1.09	0.083
59	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
60	1.62	1.75	1.85	1.96	2.12	1.85	1.09	0.083
61	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
62	1.62	1.75	1.85	1.96	2.12	1.85	1.09	0.083
63	1.62	1.75	1.85	1.96	2.12	1.85	1.09	0.083
64	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
65	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
66	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083
67	1.62	1.75	1.85	1.96	2.13	1.86	1.09	0.083
68	1.62	1.75	1.85	1.96	2.12	1.85	1.09	0.083
69	1.62	1.75	1.85	1.96	2.13	1.86	1.09	0.083
70	1.62	1.75	1.85	1.96	2.13	1.85	1.09	0.083

In section 4.3.3, (deterministic) default surface areas are provided. Realistic default surface areas should correspond with the (deterministic, 25th percentile) default body weights (section 4.3.2). In Figure A4, the correlation between surface area and body weight is shown. The clear positive correlation indicates that a low percentile (e.g. the 25th percentile) should be regarded as the default to be consistent with the default body weights. The data in Figure A4 are the raw data as obtained from de Wilde and Blokstra (2013). The number of records in Figure A4 are not exactly the same as the (summed) number of records in Table A1 because, for a few (15) records, no body weights and/or surface areas are available.

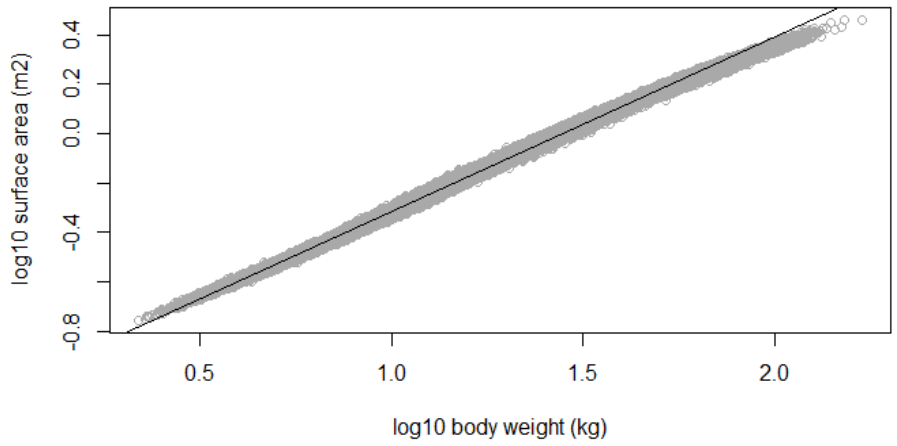


Figure A4: The correlation between the body weights and surface areas of 213,875 records (all ages, grey circles). In fitting the straight line, both variables are treated as random variables, with different errors. The fitted regression line has an intercept of -1.02 and a slope of 0.70. The correlation coefficient is 0.99.

Next to the age-specific summary statistics, several age groups as recommended by WHO are analyzed as well (see Table A6). It should be noted that WHO recommends ranges of ages, which is convenient when dealing with raw data. In that case, data of e.g. children of exactly 2 years old will be scarce and pooling data from $2\frac{0}{365}$ year to $2\frac{364}{365}$ year can provide a sufficient sample size. In our approach, simulating fractions of ages is possible but unnecessary because sufficient individuals of a particular age, e.g. of exactly 2 years old, can be simulated. To approach the WHO groups (weighted for age and ethnicity), groups are created as listed in Table A6. Since no demographic data is available per month (between 0 and 1 year), it is assumed that birth incidences are evenly spread over the months of a year.

Table A6: Age groups

WHO age groups	Ages pooled to approach WHO groups
Birth to <1 month	0 & 1 month
1 to <3 months	1, 2 and 3 months
3 to <6 months	3, 4, 5 and 6 months
6 to <12 months	6, 7, 8, 9, 10, 11 and 12 months
1 to <2 years	1 and 2 years
2 to <3 years	2 and 3 years
3 to <6 years	3, 4, 5 and 6 years
2 to <6 years	2, 3, 4, 5 and 6 years
6 to <11 years	6, 7, 8, 9 10 and 11 years
11 to <16 years	11, 12, 13, 14, 15 and 16 years
16 to <21 years	16, 17, 18 years
16+ years	18, 19, 20, ….., 70 years

Age group and sex-specific results are reported in Tables A7, 8 and 9 for body weight, height and surface area. Reported percentiles are derived from the raw (simulated) data without assuming a distribution. GM and GSD are the back-transformed mean and SD of the log transformed raw (simulated) data. For most age groups, GMs and GSDs are not reported because visual inspection of the qq-plots of the raw data (not shown) showed multimodal distributions, which cannot be characterized with a mean and standard deviation in a straightforward fashion.

Table A7a: Summary statistics for body weight (kg) of men

Age	P05	P25	P50	P75	P95	GM	GSD	CV
0-1 month	1.6	2.1	3.1	4.5	5.3			
1-3 months	3.9	4.7	5.4	6.2	7.3			
3-6 months	5.4	6.4	7.1	8.0	9.3			
6-12 months	7.0	8.3	9.2	10.3	11.9			
1-2 years	8.6	10.1	11.5	13.2	15.5			
2-3 years	10.9	12.7	14.1	15.7	18.2			
3-6 years	13.3	15.9	18.2	20.8	24.8			
2-6 years	11.8	14.5	17.2	20.1	24.3			
6-11 years	19.7	24.4	29.7	36.1	44.8			
11-16 years	36.8	45.1	52.8	61.2	73.2			
16-18 years	54.1	62.2	68.4	75.4	86.6	68.4	1.15	0.14
18-70 years	67.0	77.2	84.9	93.5	107.3	84.9	1.15	0.14

Table A7b: Summary statistics for body weight (kg) of women

Age	P05	P25	P50	P75	P95	GM	GSD	CV
0-1 month	2.1	2.6	3.3	4.2	5.0			
1-3 months	3.6	4.3	5.0	5.7	6.7			
3-6 months	5.0	5.8	6.5	7.3	8.6			
6-12 months	6.5	7.6	8.5	9.6	11.2			
1-2 years	8.0	9.4	10.9	12.6	14.9			
2-3 years	10.4	12.1	13.6	15.2	17.7			
3-6 years	12.9	15.5	17.8	20.5	24.5			
2-6 years	11.3	14.0	16.8	19.8	24.0			
6-11 years	19.3	24.2	29.6	36.1	44.9			
11-16 years	36.5	44.4	51.2	58.4	69.2			
16-18 years	49.1	56.4	62.1	68.3	78.4	62.1	1.15	0.14
18-70 years	55.8	64.1	70.6	77.7	89.2	70.6	1.15	0.14

Table A7c: Summary statistics for body weight (kg) of men & women

Age	P05	P25	P50	P75	P95	GM	GSD	CV
18-70 years	58.5	68.8	77.4	87.1	102.3	77.4	1.19	0.17

Table A8a: Summary statistics for height (cm) of men

Age	P05	P25	P50	P75	P95	GM	GSD	CV
0-1 month	45.8	48.7	51.7	54.6	57.5			
1-3 months	52.3	55.3	57.9	60.3	63.5			
3-6 months	58.5	61.7	64.2	66.7	70.1			
6-12 months	65.5	69.5	72.6	75.7	79.6			
1-2 years	72.6	76.4	82.0	88.5	93.2			
2-3 years	84.2	88.5	92.9	97.4	102.4			
3-6 years	94.1	101.0	108.1	114.8	122.2			
2-6 years	86.3	95.4	104.8	113.2	121.5			
6-11 years	115.1	124.5	134.6	144.6	155.2			
11-16 years	146.8	156.2	163.8	171	180.1			
16-18 years	164.2	170.9	175.8	180.8	188.1	175.8	1.04	0.041
18-70 years	171.0	178.0	183.0	188.2	196.1	183	1.04	0.042

Table A8b: Summary statistics for height (cm) of women

Age	P05	P25	P50	P75	P95	GM	GSD	CV
0-1 month	46.1	48.9	51.3	53.7	56.4			
1-3 months	51.3	54.2	56.5	58.8	61.9			
3-6 months	57.0	60.1	62.5	64.9	68.1			
6-12 months	63.9	67.7	70.8	73.8	77.7			
1-2 years	71.0	74.7	80.5	87.1	91.7			
2-3 years	82.9	87.1	91.6	96.2	101.1			
3-6 years	93.0	100.0	107.3	114.3	121.7			
2-6 years	84.9	94.2	103.9	112.6	121.0			
6-11 years	114.8	124.3	134.5	144.1	154.2			
11-16 years	145.4	153.6	159.7	165.5	173.5			
16-18 years	156.6	162.8	167.3	172.0	178.8	167.3	1.04	0.041
18-70 years	159.2	165.5	170	174.7	181.7	170.0	1.04	0.040

Table A8c: Summary statistics for body height (cm) of men & women

Age	P05	P25	P50	P75	P95	GM	GSD	CV
18-70 years	161.5	169.5	176.3	183.5	193.1	176.4	1.06	0.055

Table A9a: Summary statistics for surface area (m^2) of men

Age	P05	P25	P50	P75	P95	GM	GSD	CV
0-1 month	0.16	0.19	0.23	0.28	0.31			
1-3 months	0.25	0.28	0.31	0.34	0.37			
3-6 months	0.31	0.35	0.37	0.40	0.44			
6-12 months	0.38	0.42	0.45	0.48	0.53			
1-2 years	0.44	0.48	0.53	0.59	0.65			
2-3 years	0.53	0.58	0.62	0.67	0.73			
3-6 years	0.61	0.69	0.76	0.83	0.93			
2-6 years	0.55	0.64	0.72	0.81	0.92			
6-11 years	0.81	0.93	1.07	1.22	1.39			
11-16 years	1.24	1.41	1.56	1.71	1.91			
16-18 years	1.59	1.73	1.84	1.95	2.12	1.84	1.09	0.087
18-70 years	1.81	1.97	2.09	2.21	2.40	2.09	1.09	0.087

Table A9b: Summary statistics for surface area (m^2) of women

Age	P05	P25	P50	P75	P95	GM	GSD	CV
0-1 month	0.18	0.20	0.23	0.26	0.29			
1-3 months	0.24	0.27	0.30	0.32	0.36			
3-6 months	0.30	0.33	0.35	0.38	0.42			
6-12 months	0.36	0.40	0.43	0.46	0.51			
1-2 years	0.42	0.46	0.51	0.57	0.63			
2-3 years	0.51	0.56	0.61	0.65	0.72			
3-6 years	0.60	0.68	0.75	0.82	0.92			
2-6 years	0.54	0.62	0.71	0.80	0.91			
6-11 years	0.80	0.93	1.06	1.21	1.39			
11-16 years	1.23	1.39	1.52	1.65	1.83			
16-18 years	1.49	1.62	1.72	1.82	1.97	1.72	1.09	0.086
18-70 years	1.60	1.73	1.84	1.94	2.11	1.84	1.09	0.085

Table A9c: Summary statistics for body surface area (m^2) of men & women

age	P05	P25	P50	P75	P95	GM	GSD	CV
18-70 years	1.65	1.82	1.96	2.11	2.33	1.96	1.11	0.107

Annex II Defaults General Fact Sheet 2006

Table A10: Default values for body weight and surface area General Fact Sheet 2006

	Default values						
	Adults		Men		Women		Quality factor Q
Weight (kg)	65		74		61		4
Surface area	(m^2)	(%)	(m^2)	(%)	(m^2)	(%)	
Total	1.75	100	1.91	100	1.68	100	4
Head	0.116	6.6	0.122	6.4	0.113	6.7	3
Trunk	0.630	36	0.695	36.4	0.585	34.8	3
Arms	0.245	14	0.273	14.3	0.232	13.8	3
Hands	0.086	4.9	0.094	4.9	0.082	4.9	3
Legs	0.560	32	0.602	31.5	0.553	32.9	3
feet	0.117	6.7	0.124	6.5	0.116	6.9	3

Table A11: Default values of body weight and body surface of children General Fact Sheet 2006

Age		Body weight (kg)		Body surface (m^2)		Body surface in %				
Months	Years	Default value[1]	Q	Default value[1]	Q	Head	Trunk	Arms and hands	Legs and feet	Q
1.5		4.30	4	0.270	3	20.4	32.2	16.9	30.5	2
4.5		6.21	4	0.346	3	19.5	32.8	17.2	30.5	2
7.5		7.62	4	0.398	3	18.5	33.5	17.4	30.6	2
10.5		8.69	4	0.437	3	17.6	34.1	17.7	30.6	2
13.5		9.47	4	0.467	3	16.9	34.3	17.9	30.9	2
	1.5	9.85	4	0.480	3	16.2	34.0	18.15	31.65	3
	2.5	12.5	4	0.575	3	14.8	33.6	18.65	32.95	3
	3.5	14.1	4	0.640	3	14.05	33.35	19.1	33.5	3
	4.5	16.3	4	0.709	3	13.4	33.05	19.5	34.05	3
	6.5	20.6	4	0.841	3	12.5	33.45	19.45	34.55	3
	9.5	28.4	4	1.05	3	11.2	33.55	19.3	35.95	3
	12.5	39.3	4	1.31	3	9.8	33.15	19.6	37.4	3
	13.5	43.9	4	1.40	3	9.4	32.75	20.0	37.8	3
	16.5	56.8	4	1.65	3	8.3	31.65	21.35	38.65	3
	17.5	58.2	4	1.67	3	8.05	32.1	21.0	38.8	3

RIVM

Committed to health and sustainability