



BSI Standards Publication

Ergonomics — Demands and availability of anthropometric and strength data of children in Europe

National foreword

This Published Document is the UK implementation of CEN/TR 17698:2021.

The UK participation in its preparation was entrusted to Technical Committee PH/9/-/4, Ergonomics - Anthropometry and Biomechanics.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 17129 7

ICS 13.180

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 May 2022.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

English Version

Ergonomics - Demands and availability of anthropometric and strength data of children in Europe

Ergonomie - Demandes et disponibilité des données anthropométriques et de force des enfants en Europe

Ergonomie - Bedarf und Verfügbarkeit von anthropometrischen und Kraftdaten von Kindern in Europa

This Technical Report was approved by CEN on 3 October 2021. It has been drawn up by the Technical Committee CEN/TC 122.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	3
Introduction	4
1 Scope.....	5
2 Normative references.....	5
3 Terms and definitions.....	5
4 Background of the project	5
5 Description of the project	6
6 Anthropometric data needed by the stakeholders.....	6
6.1 General.....	6
6.2 Head measurements.....	9
6.3 Hand measurements.....	10
6.4 Foot measurements	12
6.5 Supine measurements.....	13
6.6 Standing measurements.....	14
6.7 Sitting measurements	18
6.8 Reach measurements	19
6.9 Strength measurements	20
7 Existing data sources	22
7.1 General.....	22
7.2 Methodology	22
7.3 Characterization of databases.....	23
7.3.1 General.....	23
7.3.2 Identification of the database.....	23
7.3.3 Context of the database	24
7.3.4 Description of the sample	25
7.3.5 Characterization of the measurement protocol	25
7.3.6 Kind of measurements.....	27
8 Information on data gaps.....	31
Annex A (informative) Definition of body measurements.....	34
Annex B (informative) Existing data sources.....	84
Bibliography	144

European foreword

This document (CEN/TR 17698:2021) has been prepared by Technical Committee CEN/TC 122 “Ergonomics”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

Introduction

The European Committee for Standardization (CEN) has carried out, within CEN/TC 122 “Ergonomics” a project to acquire anthropometric and strength data of children in Europe, initiated by the lack of published data. These data have to be current and reliable being the basis for the safety, comfort and usability of products used for or with children. From the economic point of view, they are the prerequisite for a successful position of European stakeholders on the international market.

At present, there is no sufficient knowledge neither on the existing anthropometric data and its availability nor on the specific demand of data from the relevant stakeholders. Therefore, the project has been divided in two phases. This technical report is a consequence of the results of the first phase of the project entitled “Analysis of the Demand and Availability of anthropometric data of children in Europe”. This first phase of the project included an extensive research on the demands, necessity and existence of Anthropometric and Strength data of European population under 18 years old. Background information and summary of this research project is provided in Clauses 4 to 8 of this Technical Report.

1 Scope

This document contains guidance on identifying reliable sources of anthropometric and strength data published since 2000 for the European population under the age of 18 years. It does not contain the anthropometric data itself.

This document is intended to give guidance to the stakeholders such as the standard writers, designers and manufacturers of products for children on how to identify currently available sources of anthropometric data that are relevant to their needs in terms of age/gender groupings, types of anthropometric data. This document also identifies the lack of data for specific applications hence implicitly indicating caution for the stakeholders

This document also provides information about the sources of anthropometric data listed within it. This information includes:

- Date of survey;
- Organization who carried out the survey;
- Geographic limitations of the survey;
- Size and gender of the population measured or scanned;
- Types of anthropometric measurements included in them.

This document has two annexes

- Annex A: Definition of body measurements;
- Annex B: Existing data sources.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Background of the project

Experts involved in several CEN Technical Committees (CEN/TC) and working for the standardization projects related to childcare products, toys and articles used by and for children have identified and emphasized the need of having precise and relevant up-to-date anthropometric data, related to the use of this kind of products.

Availability of correct anthropometric data and the use of updated data are important due to the changes in body measures and physical strengths of children along the past 30 years and no European-wide collection of data has been recently conducted to fill the gap in this population.

5 Description of the project

In order to describe the current scenario of anthropometric data of children in Europe, the first phase of the project comprised the following aims:

1. Research on the existence, quality and availability of anthropometric data of children in Europe.
2. Research on the demands from relevant stakeholders on anthropometric data of children with regard to the application of anthropometric data.
3. Comparison of the existence/availability of, and the demands for anthropometric data in order to identify the gap between available data and demands concerning their application.

6 Anthropometric data needed by the stakeholders

6.1 General

The demands on anthropometric data has been explored using an *online questionnaire* that has been sent to a long list of stakeholders with needs of children anthropometric and strength data. The stakeholders that have answered the questionnaire were distributed along different groups whose professional activity is related with the design, evaluation and/or commercialization of products for children. A set of *workshops* and individual *interviews* were also performed in order to obtain more detailed information about the demands on children anthropometry and strengths.

Finally, **251 participants from 204 organizations, institutions and companies** answered the questionnaire and **20 participants from 18 organizations, institutions and companies** have participated in the workshops and interviews.

The charts below show the profile of the **participants in the questionnaires**. Figure 1 shows the number of participants in the survey shorted by professional profile. The stakeholders that have filled out the questionnaire mainly belong to the areas of **industry** (designer/product developer and quality expert), **standardization** and **research**. In addition, some participants belong to other areas of industry (marketing, sales, and management) and the areas of laboratories, representative bodies of sector (industrial associations) and consumer associations.

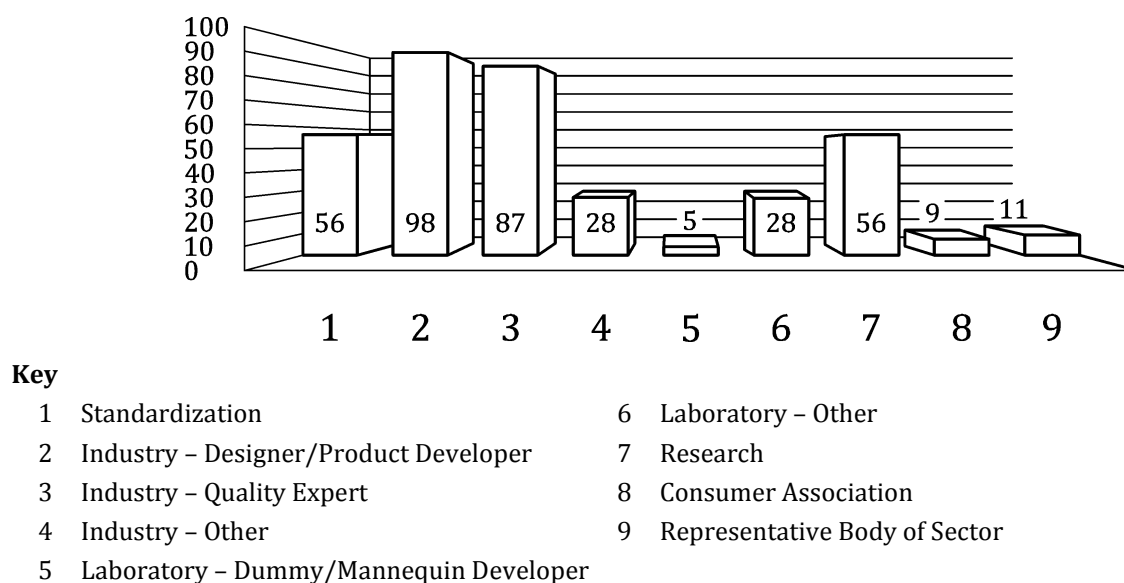


Figure 1 — Profile of the participants in the questionnaire

Figure 2 shows the percentage of participants by sector that have answered the questionnaire. In 'Other', sectors such as personal protective equipment and consumer goods are included. **73 % of participants were from Standardization Technical Committees.**

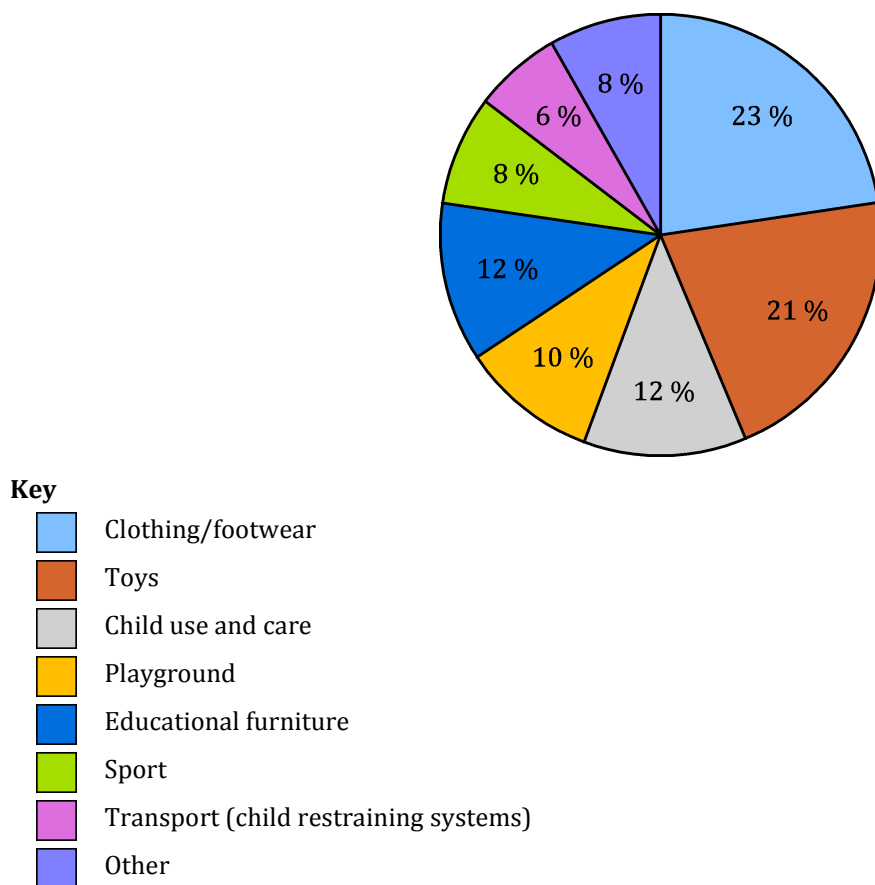


Figure 2 — Online questionnaire: Participation by sector

The **28 participants in the workshops and interviews** are mainly from areas of the Industry (Designer/Product developer) and Research laboratories/Universities (21 %), but also others from the Standardization and Consumer associations (6 %), R&D departments or associations of the Industry (3 %) and Certification laboratories (4 %) have participated.

Figure 3 shows the percentage of participants by sector that have participated in the workshops and interviews.

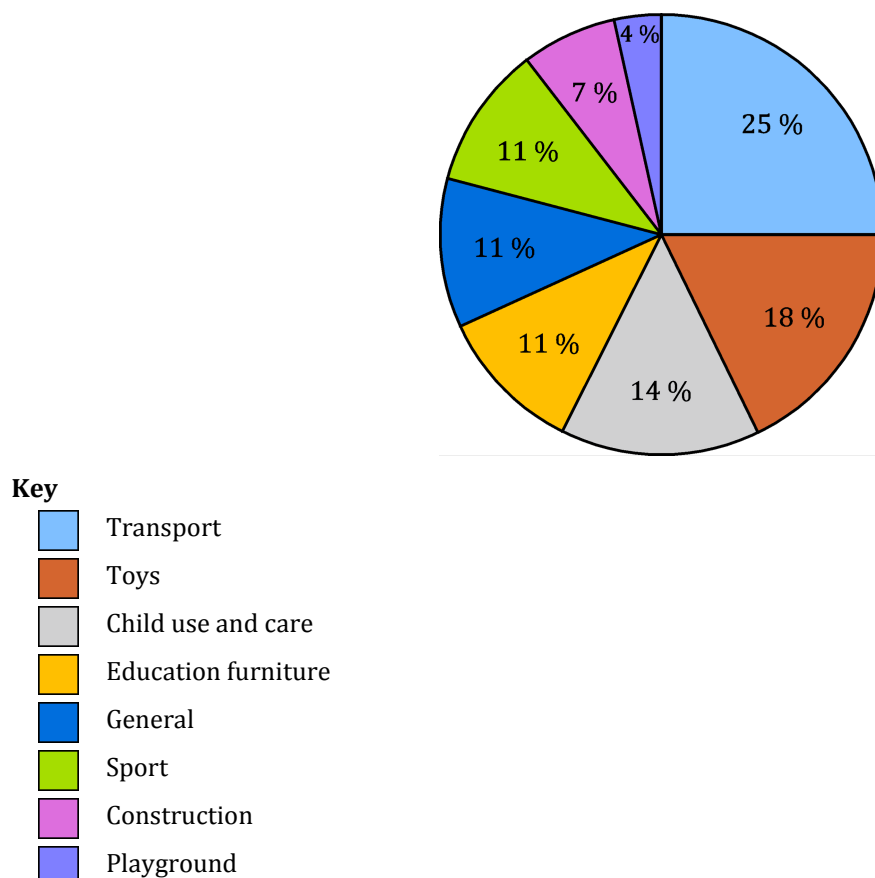


Figure 3 — Workshops and Interviews: Participation by sector

The measurements, sorted by sector and kind of measurement or part of the body, that are relevant for the participants in the questionnaires, workshops and interviews are shown in the following sections.

The colour of the cell is related with the importance of the measurement for the sector. Therefore:

- Measurements in **green** colour are highlighted by 50 % of the respondents of the questionnaires and the participants in the workshops consider them **highly relevant**.
- Measurements in **yellow** colour are highlighted by 25 % of the respondents of the questionnaires and the participants in the workshops consider them **relevant**.
- Measurements in **white** colour were not mentioned as relevant or necessary for the sector.

The description and illustrations of the measurements are included in the **Annex A**.

6.2 Head measurements

Head	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1 Head breadth	R	HR	R	HR	HR	R	HR	HR	HR
2 Ear-to-ear (bitragion) breadth		R							R
3 Face breadth (bizygomatic or cheekbones)									
4 Face breadth (brow ridges)									
5 Jaw breadth									
6 Eye separation (Interpupilar distance)									
7 Neck breadth	R	HR	R		R	R	R	HR	HR
8 Bitragion arc of the head									
9 Neck circumference/Neck girth	R	HR	HR		HR	HR	R	R	HR
10 Neck-base girth	R		R			R		R	R
11 Head circumference/Head girth	R	HR	HR		HR	HR		R	HR
12 Sagittal arc of the head		R		R		R			R
13 Head length		HR	R		R	R	HR		HR
14 Maximum head diameter (chin to back of head)		HR	HR		HR				HR
15 Head height (7th Cervicale)			R			R	R	R	R
16 Head height (Vertex to chin)	R	HR	HR	HR		R	R	R	HR
17 Face height									
18 Face length (menton-sellion)									
19 Mouth breadth			HR						HR
20 Mouth opening (between incisors)	R		HR						HR

6.3 Hand measurements

	Hand	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1	Hand length (stylium to wrist crease)	R	R	R	R	R	R	R	R	R
2	Palm length perpendicular				R		R		R	R
3	Hand length (to thumb crotch)		R	R		R			HR	HR
4	Hand breadth at metacarpals	R	HR	R	R	HR	R		HR	HR
5	Hand breadth at thumb	R	HR	HR	HR	R	R	R	HR	HR
6	Hand circumference at palm	R	R	HR	HR	HR	R		R	HR
7	Thumb breadth at distal joint		R	HR	HR	HR	R		R	HR
8	Index finger breadth, distal		R	HR	HR	HR			HR	HR
9	Index finger breadth, proximal		R	R	HR	R			R	HR
10	Middle finger breadth at distal joint			HR	HR	HR			HR	HR
11	Middle finger breadth at middle joint			R	HR	R			R	HR
12	Third finger breadth at distal joint			HR	HR	HR			HR	HR
13	Third finger breadth at middle joint			R	HR	R			R	HR
14	Little finger breadth at distal joint		R	HR	HR	HR			HR	HR
15	Little finger breadth at middle joint		R	R	HR	R			R	HR
16	Middle finger length (distal joint to tip)		R	HR	HR	HR			HR	HR
17	Middle finger length (middle joint to distal joint)			R		HR			R	HR
18	Thumb length					HR	R		R	HR
19	Index finger length	R				HR	R		R	HR
20	Middle finger length	R	HR			HR	R		R	HR
21	Third finger length					HR	R		R	HR
22	Little finger length					HR	R		R	HR

Hand	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
23 Hand depth	R	R	HR	HR	R		R	R	HR
24 Hand clearance (maximum aperture)	R	R		HR	R			R	HR
25 Middle finger depth at distal joint				HR	R				HR
26 Middle finger depth at middle joint				HR	R			R	HR
27 Fist depth	R	R	R	HR	R			R	HR
28 Fist circumference			R		R				R
29 Middle finger length (knuckle to middle joint, hand clenched)	R								R
30 Fist breadth	R	R	HR	HR	R			HR	HR
31 Maximum grip diameter (between thumb and index finger)		HR	HR	HR	HR		R	R	HR
32 Maximum grip diameter (between thumb and middle finger)	R	HR	R	HR	HR			R	HR
33 Grip length (middle finger to thumb)	R	HR	R					R	HR
34 Thumb diameter (minimum aperture)		R	R	HR	HR			R	HR
35 Index finger diameter (minimum aperture)	R	R	HR	HR	HR			HR	HR
36 Middle finger diameter (minimum aperture)	R	R	HR	HR	HR			R	HR
37 Little finger diameter (minimum aperture)		HR	HR	HR	HR			R	HR

6.4 Foot measurements

Foot	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1 Foot length	R	HR	R	HR	HR	HR	R	HR	HR
2 Forefoot length		R	R						R
3 Distance heel — 1st metatarsal						R			R
4 Distance heel — 5th metatarsal								R	R
5 Toes width								HR	HR
6 Foot breadth	R	HR	R	HR	HR	R	R	HR	HR
7 Heel breadth		R				R			R
8 Ankle breadth	R	HR				R			HR
9 Toes girth									
10 Ball girth			R			R			R
11 Instep girth						R			R
12 Minimum leg girth						R			R
13 Ankle circumference		R				R			R
14 Heel to instep girth						R			R
15 Foot height		HR		HR	HR	R		HR	HR
16 Height of 1st toe		R	R	HR				HR	HR
17 Height of 1st metatarsal		R	R		HR			HR	HR
18 Height of 5th toe								HR	HR
19 Height of 5th metatarsal								HR	HR
20 Instep height			R			R		HR	HR
21 Heel height									
22 Ankle height	R	R				R		HR	HR

6.5 Supine measurements

Measurements in supine posture are a specific set of the standing measurements that are taken in children under 24 months and only before they can stand up.

	Supine	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1	Body mass ¹	HR	HR	HR	HR	HR		HR	HR	HR
2	Body length, crown to sole (Supine) / recumbent length	R	HR	HR		HR	R	HR	HR	HR
3	Shoulder height (supine)		HR	R		R	R	HR		HR
4	Elbow height (supine)		R	R		R	R	R		R
5	Sitting height/Crown to rump (supine)		HR	HR		HR	R	HR	HR	HR
6	Leg length, buttock to sole (supine)	R	HR	R		HR	R	HR	R	HR
7	Hip depth (supine)		R	R		HR	R	R	R	HR
8	Buttock to popliteal length (supine)	R	R	R		R		R		R
9	Lower leg length, popliteal to sole (supine)		R	R		R	R	R		R
10	Lower leg length, knee to sole (supine)		R			R	R	R	R	R
11	Mid-thigh depth (supine)		R			HR		R		HR
12	Waist breadth (in infants)		HR	HR		HR	R	HR	R	HR
13	Hip breadth, standing (maximum in infants)	R	HR	HR		HR	R	HR	R	HR
14	Waist circumference (maximum in infants)		R	R		HR	R	R		HR
15	Mid-thigh girth (supine)		R				R	R		R

¹ The body mass had not been addressed in the questionnaire described in 6.1 and its relevance for the sectors was, therefore, based on literature [7].

6.6 Standing measurements

Standing	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1 Body mass ²	HR	HR	HR	HR	HR		HR	HR	HR
2 Stature	R	HR	HR	HR	HR	HR	HR	HR	HR
3 Eye height (from floor)					HR		R	R	HR
4 Chin height		R		HR					HR
5 Back neck height/Cervicale height	R	HR			HR		R		HR
6 Shoulder height from floor	R	R	HR		HR		R	R	HR
7 Chest height at armpit					R				R
8 Iliac spine height, standing						R			R
9 Hip height at trochanter						R		R	R
10 Waist height		R							R
11 Upper hip height						R			R
12 Top hip height						R			R
13 Maximum hip girth height / Buttock height at maximum depth						R			R
14 Crotch height / Inside leg height	R	HR			R	HR	R		HR
15 Buttock height at gluteal furrow	R	R			R		R	R	R
16 Torso height						HR	R		HR
17 Back neck point to ground (contoured)						R		R	R
18 Back neck point to knee								R	R
19 Diagonal trunk girth						R			R
20 Centre trunk length					HR	HR			HR

² The body mass had not been addressed in the questionnaire described in 6.1 and its relevance for the sectors was, therefore, based on literature [7].

Standing	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
21 Shoulder breadth (bideltoid)	R	HR					R	R	HR
22 Shoulder breadth (biacromial)						R			R
23 Elbow to elbow breadth		R			HR		R	R	HR
24 Shoulder slope					HR	R			HR
25 Back shoulder width						R			R
26 Shoulder length						HR			HR
27 Back width (armpit level)					R	R			R
28 Across back width						R			R
29 Back neck point to waist						HR	R		HR
30 Scye depth						R			R
31 Back point to bust point						R			R
32 Back neck point to waist level						R			R
33 Bust points around neck						R			R
34 Side neck point to bust point						R			R
35 Side neck point to waist level						R			R
36 Front width (armpit level)						R			R
37 Chest depth, standing			R			R			R
38 Thorax depth/Bust depth			R			R			R
39 Body depth, standing			R			R			R
40 Abdomen/hip depth						R		R	R
41 Straight body rise						HR			HR
42 Total crotch length						HR			HR
43 Front crotch length						HR			HR

Standing	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
44 Back crotch length						HR			HR
45 Side waist to hip						R			R
46 Waist to hips (trochanter)						HR			HR
47 Chest breadth at armpit						R			R
48 Chest breadth, standing (mesosternal level)									
49 Bust point width						R			R
50 Chest breadth at nipples							R	R	R
51 Waist breadth (at navel)			HR		HR			R	HR
52 Hip breadth (trochanter)		HR	HR				R	R	HR
53 Chest circumference/Bust girth						HR		R	HR
54 Chest girth (at axilla)						HR			HR
55 Underbust girth						HR			HR
56 Mid-riff girth						R			R
57 Waist circumference / Waist girth						HR			HR
58 Hip circumference (buttock)/Hip girth			HR			HR	R		HR
59 Hip circumference (trochanter)			HR			HR	R	R	HR
60 Upper arm depth						R			R
61 Lower arm breadth								R	R
62 Wrist breadth						R			R
63 Wrist depth						R			R
64 Upper arm length						HR	R		HR
65 Outer arm length						HR	R		HR
66 Back neck point to wrist length						HR	R		HR
67 Underarm length						R		R	R

Standing	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
68 Elbow-wrist length					HR	R			HR
69 Forearm-fingertip length	R	R			HR		R	R	HR
70 Armscye girth						R			R
71 Upper arm circumference at armpit		R				HR		R	HR
72 Upper arm girth		R				HR			HR
73 Elbow girth		R				HR			HR
74 Lower arm circumference		R				R			R
75 Wrist circumference		R	R			HR			HR
76 Outside leg length						HR	R	R	HR
77 Thigh length						HR	R		HR
78 Knee height (midpatella), standing	R	R			R	HR			HR
79 Tibiale height	R	R				R			R
80 Calf height (at maximum circumference)						R			R
81 Upper thigh depth						R			R
82 Calf depth									
83 Thigh circumference						HR			HR
84 Mid-thigh girth						R			R
85 Knee girth		R				HR			HR
86 Lower knee girth		R				R			R
87 Calf circumference		R				R			R

6.7 Sitting measurements

Sitting	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1 Sitting height	R	HR	HR		HR	R	HR	HR	HR
2 Eye height, sitting			R		HR		HR		HR
3 Cervical height, sitting/Back neck height, sitting	R				HR	R			HR
4 Shoulder height, sitting			HR		HR	R			HR
5 Shoulder- elbow length		R	R		HR	R	HR		HR
6 Elbow height, sitting					HR	R	R	R	HR
7 Hip breadth, sitting (maximum when seated)	R	HR	R		HR	R	HR	HR	HR
8 Thigh breadth (maximum when seated)					HR		R		HR
9 Knee breadth, sitting					HR		R		HR
10 Abdominal depth, sitting					HR	R	HR		HR
11 Buttock-abdomen depth, sitting		R			HR	R	HR	HR	HR
12 Buttock-popliteal length, sitting (seat depth)	R	R	HR		HR		HR		HR
13 Buttock-knee length, sitting	R	R	R		HR		R	R	HR
14 Thigh clearance, (depth) sitting			R		HR	R	HR		HR
15 Knee height, sitting	R	HR	R		HR	R	HR	R	HR
16 Popliteal height, sitting	R	HR	HR		HR		HR	R	HR

6.8 Reach measurements

Reach	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
1 Span	R	HR	HR		R			HR	HR
2 Elbow span		R			R		R	R	R
3 Sideways reach to grip (standing)		HR			HR			HR	HR
4 Knuckle height (from floor)		R			HR			R	HR
5 Middle finger tip height (from floor)					R			R	R
6 Fist (grip axis) height		R						R	R
7 Wall-acromion distance		R							R
8 Arm length to fingertip	R	R	HR		HR		R	HR	HR
9 Arm length to grip		HR			HR				HR
10 Forward reach to grip (standing)/Grip reach, standing	R	HR			HR			HR	HR
11 Elbow height (from floor)	R	R			HR			HR	HR
12 Elbow — grip length		R						R	R
13 Step height	R	HR	HR		HR			HR	HR
14 Overhead reach to grip (standing)	R	HR	R	HR	HR		R	R	HR
15 Overhead reach to fingertip (on tiptoes)		HR		HR	R				HR
16 Overhead reach to fingertip (jumping)		HR							HR
17 Overhead reach to grip (sitting)		HR	R		HR		R	HR	HR
18 Forward reach to grip (sitting)		R	HR		HR		R	R	HR
19 Forward reach to grip (stretching and seated)		R	HR		R			R	HR
20 Forward reach to fingertip (stretching and seated, legs outstretched)		R			R			R	R
21 Leg length, buttock to sole (sitting)		HR			HR		R		HR

6.9 Strength measurements

Strength measurements	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
Hand strength									
1 Finger Push	R	R	HR		HR		R	HR	HR
2 Pinch (finger tips)	R	R	HR		HR		HR	R	HR
3 Pinch (lateral)	R		R		HR		R		HR
4 Pinch-Pull	R	R	HR	HR	HR		R	R	HR
5 Hand Grip	R	HR	R		HR				HR
6 Hand pushing	R	R	HR		HR				HR
7 Hand Pulling	R	HR	HR	HR	HR				HR
8 Shear			R		HR				HR
Wrist strengths									
1 Twisting (with hand)	R	R	HR	HR	HR			HR	HR
2 Twisting (with finger tips)			HR		HR			R	HR
3 Opening			R		HR			R	HR
Leg/feet strengths									
1 Press with the foot	R		R	R	HR			HR	HR
2 Feet pushing forwards				R	HR			R	HR
3 Lift with the foot	R	HR		R	HR			R	HR

Strength measurements	Toys	Playground	Child use and care	Sport	Educational furniture	Clothing	Restraint transport	Construction	Global
Mouth strengths									
1 Biting	R		HR		HR		R		HR
2 Lip strength			R					R	R
Upper body/trunk strengths									
1 Pushing forwards	R	R	HR	R	HR			HR	HR
2 Pushing downwards	R	R	HR	R	HR			HR	HR
3 Pushing sideways		R	R	R	HR			R	HR
4 Pulling	R	R	HR	R	HR			HR	HR
5 Lifting		R	HR	R	HR			R	HR
6 Hitting force	R	R	R	R	R			R	R
7 Pushing with the shoulder		R			HR			R	HR
8 Hanging by the arms	R	R			R			R	R
9 Chair push-up		R	R		HR				HR

7 Existing data sources

7.1 General

An exhaustive search on the existing anthropometric and strength data of children relevant for the design of safety and ergonomic products has been carried out in the project, identifying all the relevant information required to analyse the scope, representability and availability of data.

7.2 Methodology

The search of data has been performed on an exhaustive set of scientific, technical and commercial literature between June 2015 and December of 2015. New studies that have been identified after this date are included in the set of existing data. The review has explored different sources of information to generate the resulting databases:

- **Scientific search engines:** Web of science, Scopus, ScienceDirect, Medline (PubMed), Plos One and Google Scholar.
- **Scientific online networks:** Researchgate. The citations of identified publications were also screened for additional resources.
- Network of contacts of CEN/TC 122 members, including technological centres, research organizations and companies.
- Information provided by experts from different CEN Technical Committees.
- Standards related to anthropometry or children products.
- Those stakeholders participating in the online survey developed in WP2, “Demands on anthropometric data”, who have informed that they have their own anthropometric database of children.
- **Google engine:** For commercial and research websites that are not published on scientific sources.

The parameters that were considered for the inclusion of data in the results of the present research are explained hereafter:

- **Geographical scope.** The review is focused on studies considering population from the EU-28, Switzerland, Turkey, Norway, Russia and Belarus.
- **Year of generation of the database.** The review has been focussed on data acquired in the year 2000 or later. Previous data could be affected by secular changes.
- **Demographic aspects.** The review includes databases of children from 0 to 18 years old of both genders. Those studies focused on pathologies have not been considered. In the case of strength review, studies focused on children involved in sport activities have not been considered.
- **Sample size.** It represents the number of children measured to generate the database. No limitation was applied to identify existing databases.
- **Acquisition procedure.** Regarding the anthropometric surveys, the review includes references involving both traditional acquisitions based on the use of instruments such as stadiometers or measuring tapes and 3D acquisitions obtained through 3D scanners or similar. Regarding strength

surveys, the review includes studies involving both measurements of isometric (static) forces and isokinetic (dynamic) forces as well as other methods.

7.3 Characterization of databases

7.3.1 General

Table of the existing data are shown in two tables in the Annexe B. Both tables have complementary information and some coincident parameters. Table B.1 contains information about the generation of the database (author, organization, year of publication, ...) and Table B.2 describes the contents of the databases regarding the kind of measurements and measurement protocols. Some parameters are repeated in Table B.1 and Table B.2 because they are useful to link both tables and to understand the contents and description of each database. The rows per page of both tables are completely aligned, so as they can be printed and physically overlapped in order to consult all the information about each data source.

The parameters of both tables are described in the sections hereafter.

7.3.2 Identification of the database

7.3.2.1 Code of the databases

The databases are named with an exclusive identifier including the following information in the codification:

- *Country*: the codification of the country is based in the system of three letters of the standard EN ISO 3166-1 alfa-3 (A3).
- *Year of publication*.
- *Year of the survey*. When the measurements have been taken.
- *Part of the body*. The codification is shown in Table 1.
- *Single identifier*. A number of two figures is used to distinguish databases that share the same previous parameters.

Table 1 — Codification of parts of the body

Parts of the body				
A0 Full body	B0 Head and neck	C0 Trunk	D0 Upper limbs	E0 Lower limbs
	B1 Head	C1 Thorax	D1 Shoulder and upper arm	E1 Hip and Thigh
		C2 Abdomen	D2 Elbow and forearm	E2 Knee and leg
	B2 Neck	C3 Pelvis	D3 Wrist and hand	E3 Ankle and foot

7.3.2.2 Study name (Title)

This is the title of the publication (paper, thesis, web name, etc.) where the study is described and some results are published.

7.3.2.3 Name of the database/study

In case that the database or the study has been named with a proper name, it is included in this parameter.

7.3.2.4 Author and organization

Name of the first author of the publication and the organization he or she belonged to when the study was published.

7.3.3 Context of the database

7.3.3.1 Year of the publication

This is the year of the publication.

7.3.3.2 Year of the survey

This is the year (or years) when the survey was performed.

7.3.3.3 Country

This is the country where the study was performed.

7.3.3.4 Area of Europe

The areas of Europe have been defined ad hoc for the project as it follows:

- *Northern Europe*: Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, Sweden, United Kingdom. Non-EU: Iceland, Norway.
- *Western Europe*: Austria, Belgium, France, Germany, Luxembourg, Netherlands. Non-EU: Switzerland.
- *Southern Europe*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain. Non-EU: Turkey, Albania, Macedonia, Serbia, Kosovo, Bosnia-Herzegovina, Montenegro.
- *Eastern Europe*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia. Non-EU: West Russia, Belarus, Moldova and Ukraine.
- *General*: Studies that include population from different countries.



Figure 4 — Regions of Europe. Blue: Northern Europe; Red: Eastern Europe; Green: Western Europe; Purple: Southern Europe

7.3.4 Description of the sample

7.3.4.1 Age range

Minimum and maximum ages of the population measured in the study.

7.3.4.2 Gender

It is referred to the gender of the population measured in the study:

- M: Only males
- F: Only females
- M&F: Both males and females have been measured in the study.

7.3.4.3 Boys sample size

Number of males measured in the study of all age groups.

7.3.4.4 Girls sample size

Number of females measured in the study of all age groups.

7.3.5 Characterization of the measurement protocol

7.3.5.1 Category

This parameter is related with the kind of dimensions considered in the scope of the study and the number of measurements taken in the survey. Seven categories have been defined in order to represent the potential of these databases in terms of kind of data and number of acquired body measurements:

- *Ant-Basic*: It includes Height and Weight and some of the following measurements: Waist circumference, Hip circumference, Head circumference, Arm circumference, Forearm circumference, Arm span and Hand breadth.
- *Ant-Reduced*: The number of anthropometric measurements is between 7 and 15 measurements, including the Basic set.
- *Ant-Mid-extended*: The number of anthropometric measurements is between 16 and 25.
- *Ant-Extended*: The number of measurements is between 26 and 60.
- *Ant-Full extended*: The number of measurements is higher than 75.
- *Ant-Body part*: Databases that are focused on gathering the anthropometry of some part of the body.
- *Strengths*: Studies that are focused on strengths, which they usually include between 1 and 12 measurements.

7.3.5.2 Measurement method

This parameter is about the measurement method that was used to gather the measurements of the population:

- *Traditional*: Anthropometric data measured using manual or traditional instruments.
- *3D Scanner*: Anthropometric measurements obtained from a 3D representation of the body, registered with a 3D scanner.
- *3D Scanner and Traditional*: The database includes measurements taken with both of the previous methods.
- *Images*: Anthropometric measurements taken from images of the body or a part of the body.
- *Images and Traditional*: The database includes anthropometric measurements taken from images and also using traditional instruments.
- *Others (anthropometry)*: Other methods different than the previous ones have been used to take anthropometric measurements.
- *Isometric*: Static forces (they do not involve the movement of the body).
- *Isometric and Isokinetic*: Both static and dynamic forces.
- *Eurofit test battery*: Studies that have measured the set of the Eurofit test battery.
- *Isometric and Others*: Both static and other kind of forces (but not dynamic forces).
- *Others (strengths)*: Other methods different than the previous ones have been used to take strength measurements.

7.3.5.3 Part of the body

This parameter is about the part of the body that has been measured or that is related with the measurements taken in the study:

- *Full body*: Both anthropometric or strength measurements that are related with the full body.
- *Head*: Anthropometric measurements of the head.
- *Hand*: Anthropometric measurements of the hand.
- *Foot and ankle*: Anthropometric measurements of feet or ankles.
- *Arms/Upper body*: Strengths performed with the arms or the upper part of the body.
- *Legs/feet*: Strengths performed with the legs or feet.
- *Hand/Wrist*: Strengths performed with the hand or the wrist.
- *Wrist*: Strengths performed with the wrist.
- *Fingers*: Strengths performed with the fingers.

7.3.6 Kind of measurements

The parameters included in this section show the kind of measurements included in the database. There are two sets of measurements and the possible values of those parameters are only three: *Yes* when this kind of data are included in the database. *Unknown* when there is a suspicion about the presence of these measurements in the database but it cannot be confirmed. *Blank* if this kind of data are not included in the database.

The two sets of parameters are the following:

- *Anthropometric measurements*. They refer to the measurements described in sections 1 to 7 of the Annex A.
 - *Basic measurements*. The database includes the basic set of anthropometric measurements (i.e. Height and Weight and some of the following measurements: Waist circumference, Hip circumference, Head circumference, Arm circumference, Forearm circumference, Arm span and Hand breadth.)
 - Hand dimensions.
 - Foot dimensions.
 - Head dimensions.
 - Seated dimensions.
 - Standing/Supine dimensions.
 - Reach dimensions.
- *Strength measurements*. They refer to the measurements described in section 8 of the Annex A.
 - *Grip strength*. This measurement is the most frequent in the studies about strengths, therefore it has been created a specific category.
 - *Measurements related to physical fitness tests*, such as explosive strength, endurance, flexibility.
 - *Hand strength*. They are related to more than one hand strength, such as grip, pinch, etc.
 - *Muscle strength*. They are related to more than one individual muscle group strength, such as elbow flexion and extension, knee flexion and extension, etc.
 - *Wrist strength*. Strength that are performed with the wrist and the hand does not have a significant role.
 - *Strength related to actions*. They are related to specific actions, such as pushing, opening, biting, etc.
 - *Trunk strength*. Strength that are performed with the trunk and the arms and hands do not play a significant role.
 - *Fingers' strength*. When the measured forces are of specific movements of the fingers.

The summary of the existing data in four age groups and organized by kind of data as it follows:

- Anthropometric data:
 - Basic dimensions;
 - Standing/Supine;
 - Seated;
 - Reaches;
 - Head;
 - Hand;
 - Foot;
- Strengths.

Table 2 — Summary of the existing data

Age range	0–2 years old	2–4 years old	5–10 years old	11–18 years old
Basic anthropometric dimensions	Databases in Northern (2db), Southern (3db), Western (3db) and Eastern Europe (1db). Statistics only in Southern and Northern Europe.	Databases in Southern (8db), Western (6db), Northern (5db) and Eastern Europe (2db) Statistics in all regions.	Databases in Eastern (5db), Northern (22db), Southern (24db) and Western (22db) Europe. Statistics in all regions.	Databases in Southern (32db), Northern (19db), Western (22db) and Eastern (10db) Europe. Statistics in all regions.
Standing/ supine	Databases in Northern (1db), Southern (3db), Western (3db) and Eastern Europe (1db). Statistics only in Southern and Northern Europe.	Databases in Southern Europe (4db) and Western Europe (7db) and uncompleted databases in Northern (4db) and Eastern Europe (1db). Traditional and 3D scanner measurements and statistics in all regions. Raw data in Western Europe and avatars in Northern and Western Europe.	Databases in: Eastern (5db): Statistics, Graphs and Avatars Northern (6db): Statistics and Avatars Southern (16db): Statistics, Graphs, Avatars and raw data Western (8db): Statistics and raw data	Databases in: Eastern (5db): Statistics, Graphs and Avatars. Southern (12db): Statistics, Graphs, Avatars and raw data. Uncompleted databases: Northern (5db): Statistics and Avatars. Western (5db): Statistics and raw data
Seated	No existing data.	Uncompleted databases in Western, Northern and Southern Europe. Published statistics only of traditional data of Western and Northern Europe.	Databases in Southern (11db) and Western (3db) Europe and uncompleted databases in Northern (3db), Eastern (2db) Europe (uncertainty).	Databases in: Southern (7db) and Western (1db) Europe and uncompleted databases in Northern (3db) and Eastern (2db) Europe.
Reaches	No existing data.	Uncompleted databases in all regions of Europe. Statistics only in Northern and Eastern Europe.	Databases in Southern (5db) Europe and uncompleted databases in Eastern (3db), Northern (3db) and Western (2db) Europe. Statistics in all regions except Northern Europe.	Uncompleted databases in Southern (3db), Eastern (3db), Northern (3db) Europe.
Head	Uncompleted database (1db) in Western Europe (3D and traditional).	Uncompleted databases with statistics in Western (3db), Southern (2db), Eastern (1db) and Northern (1db) Europe.	Databases in Western (2db), Southern (1db) and Northern (3db) Europe. 3D scanner measurements from the Northern (1db) and Western (1db) databases. Images from the same three regions. No data in Eastern Europe.	Uncompleted data in Northern (2db) Europe.

Age range	0-2 years old	2-4 years old	5-10 years old	11-18 years old
Hand	No existing data.	Uncompleted databases in Northern and Southern Europe.	Databases in Southern (2db), Northern (6db) and Western (2db) Europe.	Uncompleted database in Northern (4db), Southern (4db), and Western (2db) Europe.
Foot	Uncompleted database in Southern and Western Europe.	Databases in Southern and Western Europe from 3D scanners.	Databases in Northern (1db), Southern (1db) and Western (1db) Europe. All data comes from 3D scanners. Statistics only published in Southern Europe. No data in Eastern Europe.	Uncompleted databases in Southern (1db) and Western (1db) Europe. Data from 3D scanners.
Strengths	No existing data.	Uncompleted databases in Northern (Arms/Upper body) and Western Europe (hand, fingers and legs-feet).	Uncompleted data in: Northern (11db): Hand, Legs-feet and full body Southern (9db): Hand and Full body Western (12db): Hand, fingers, wrist, legs-feet and Full body	Databases in: Northern (9db): Hand, legs-feet and arms-upper body and full body. Southern (15db): Hand, arms-upper body and full body Western (12db): Hand, wrist, fingers, legs-feet and full body.

8 Information on data gaps

The summary of the main gaps regarding the existence of anthropometric and strength data of European children are listed in the table below, considering the existence of 2D-3D anthropometric databases.

The summary of the gaps among the databases is also organized in four age groups and by kind of data as it follows:

- Anthropometric data:
 - Basic dimensions;
 - Standing/Supine;
 - Seated;
 - Reaches;
 - Head;
 - Hand;
 - Foot;
- Strengths.

Age range	0-2 years old	2-4 years old	5-10 years old	11-18 years old
Basic anthropometric dimensions	Missing statistics in Eastern and Western Europe.	No lack of data.	No lack of data.	No lack of data.
Standing/ supine	Missing statistics in Eastern and Western Europe.	Northern: Missing age groups. Eastern: Missing sample and age groups. Western and Southern: No lack of data.	Eastern, Western and Northern: Missing age groups. Southern: No lack of data.	Eastern, Southern: No lack of data. Northern: Missing age groups. Western: Not enough information to conclude.
Seated	Missing data in all regions of Europe.	Eastern Europe: Missing data. Western: Not enough information to conclude. Southern and Northern: Missing age groups.	Eastern: Missing age groups. Northern: Missing age groups and sample.	Eastern: Missing age groups. Northern: Missing age groups.
Reaches	Missing data in all regions of Europe.	Southern and Eastern: Missing age groups and set of measurements. Northern and Western: Missing data.	Eastern: Traditional and 3Dscanner. Northern: Missing sample size. Southern and Western: No lack of data.	Eastern: Missing age groups and sample. Southern: Missing age groups and sample. Northern and Western: Missing data.
Head	Missing data in Southern, Northern and Eastern Europe.	Western Europe: Missing sample size. Southern, Northern and Eastern: Missing age groups.	Northern: Missing age groups. Southern: Missing age groups and sample. Western: Missing age groups of traditional or 3Dscanner. Easter: Missing data.	Missing data in all regions of Europe.
Hand	Missing data in all regions of Europe.	Western and Eastern Europe: Missing data Southern Europe: Missing age groups. Northern Europe: Missing sample size and measurements.	Northern: Missing sample and age groups. Western: Missing sample. Eastern: Missing data.	Missing data in Eastern Europe. Missing age groups and sample in other regions.

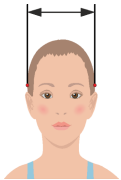
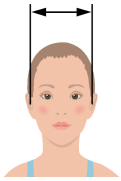
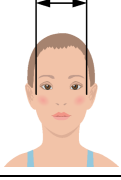
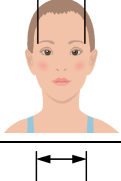
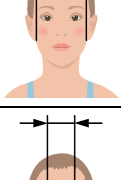
Age range	0-2 years old	2-4 years old	5-10 years old	11-18 years old
Foot	Missing age groups in Southern and Western Europe and missing data in Northern and Eastern Europe.	Missing data in Northern and Eastern Europe.	Northern Europe: Missing age groups. Eastern Europe: Missing data.	Missing data in Eastern and Northern Europe. Southern and Western Europe: Missing age groups.
Strengths	Missing data in all regions of Europe.	Western and Northern Europe: Missing age groups and set of measurements. Southern and Eastern regions: Missing data.	Missing data in Eastern Europe.	Missing data in Eastern Europe.

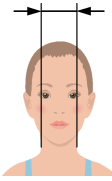
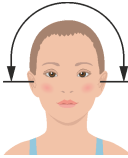
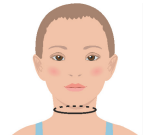
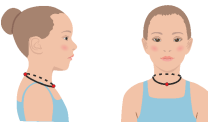
Annex A (informative)

Definition of body measurements

Tables A.1 to A.8 provide information on the definition of body parts for which anthropometric data are provided in one or more data sources listed in Table B.1. Where available, references to the international anthropometric definitions in EN ISO 7250-1:2017 and/or ISO 8559-1:2017 are made for each body dimension.

Table A.1 — Head

Head		
1	Head breadth (EN ISO 7250-1:2017, 6.3.10 - Childdata: 8) Maximum breadth of head above the level of the ears, measured perpendicular to the midsagittal plane. Position of head has no influence on the measurement. <i>Instrument: Spreading caliper</i>	
2	Ear to ear (bitracion) breadth (Childdata: 13) The distance from the right to the left tracion (the cartilaginous or fleshy projection in front of the entrance to the ear). The subjects sit erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides.	
3	Face breadth (bizygomatic or cheekbones) (Childdata: 14) The maximum horizontal breadth of the face between the cheekbones (the zygomatic arches) The subject sits erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides.	
4	Face breadth (brow ridges) (Childdata: 15) The horizontal distance across the bony ends of the brow ridges. The subjects sit erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides.	
5	Jaw breadth (Childdata: 16) The maximum breath at the lowest and widest points on the jaw bone (mandible) is measured (between the left and right gonion). The subject is placed or held in seated position.	
6	Eye separation (Interpupilar distance) (Childdata: 21) The horizontal distance between the centres of the pupils of the eyes with the subject looking straight ahead.	

Head		
7	Neck breadth (Childdata: 25) The breadth at the mid-point of the neck perpendicular to the long axis of the neck is measured. The subject sits erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides.	
8	Bitrignon arc of the head (EN ISO 7250-1:2017, 6.3.14) Arc from one trignon over the crown of the head to the other trignon perpendicular to the Frankfurt and sagittal arc. Tape measure is held on the trignon of one side of the head and led over the crown to the trignon on the other side. Hair shall be included in the measurement. <i>Instrument:</i> Tape measure.	
9	Neck circumference (EN ISO 7250-1:2017, 6.4.9) — Neck girth (ISO 8559-1:2017, 5.3.2) Girth of the neck at a point just below the bulge at the thyroid cartilage (Adam's apple), and measured perpendicular to the longitudinal axis of the neck. Subject sits or stands erect with head in the Frankfurt plane. <i>Instrument:</i> Tape measure.	
10	Neck-base girth (ISO 8559-1:2017, 5.3.3) Girth of the base of the neck measured over back neck point and the front neck point. Subject sits or stands erect with head in the Frankfurt plane. <i>Instrument:</i> Tape measure, or Chainette and scale.	
11	Head circumference (EN ISO 7250-1:2017, 6.3.12)/Head girth (ISO 8559-1:2017, 5.3.1) — Childdata: 10 Maximum, approximately horizontal, girth of head measured above centre point of brow ridge and crossing the rearmost point of the head. Hair shall be included in the measurement. Subject sits or stands erect with head in the Frankfurt plane. <i>Instrument:</i> Tape measure.	
12	Sagittal arc of the head (EN ISO 7250-1:2017, 6.3.13) Arc from the glabella over the skull to the nuchale. Tape measure is held on the glabella and led over the head so as to pass over the rearmost point of the skull to the nuchale. Hair shall be compressed. <i>Instrument:</i> Tape measure	
13	Head length (EN ISO 7250-1:2017, 6.3.9) — Childdata: 9 The distance along a straight line from the most anterior protrusion of the forehead (glabella) to the most posterior point on the back of the head (opisthocranium). Position of head has no influence on the measurement. <i>Instrument:</i> Spreading calliper	
14	Maximum head diameter (chin to back of head) (Childdata: 12) The rectilinear distance from the chin to the crown of the head. The subjects stand erect with head in the Frankfurt plane and jaws closed. <i>Instrument:</i> Spreading calliper.	

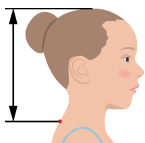
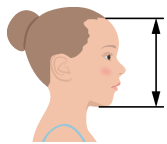
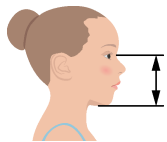
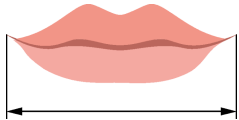
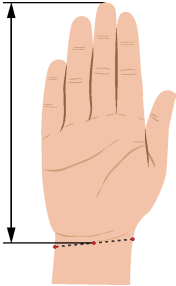
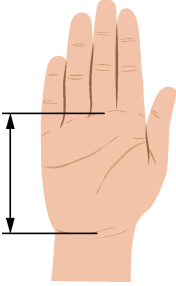
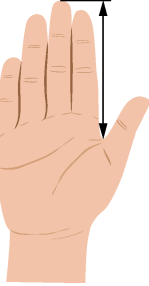
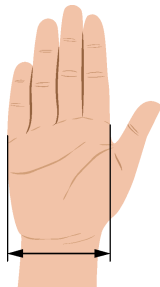
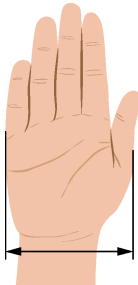
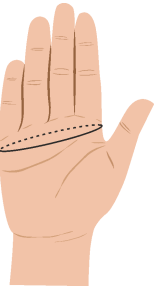
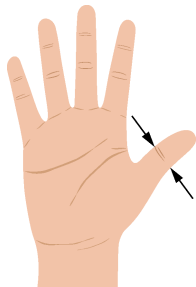
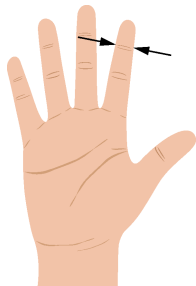
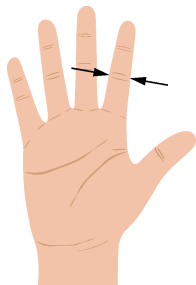
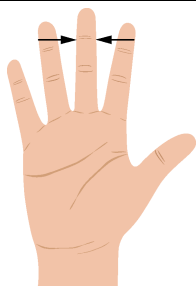
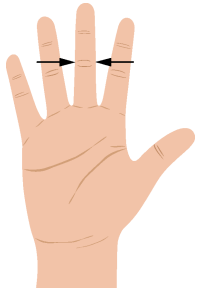
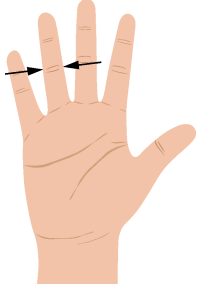
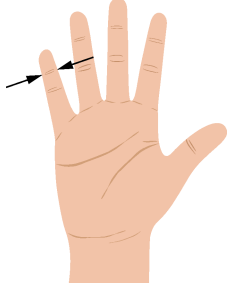
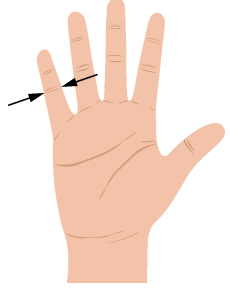
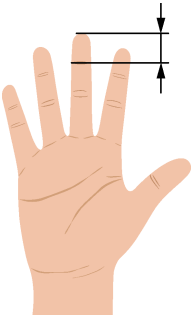
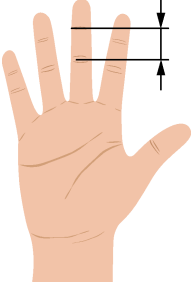
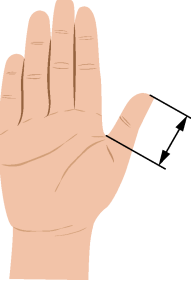
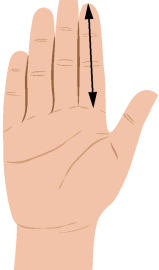
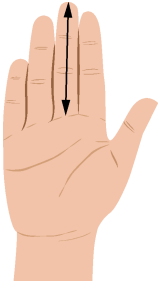
Head		
15	Head height (7th Cervicale) The height of the head from the vertex (top of the head) to the 7th Cervicale. The subjects sit erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides.	
16	Head height (Childata: 11) The height of the head from the vertex (the top of the head) to the menton (bottom of the chin). The subjects sit erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides. <i>Instrument: Sliding caliper</i>	
17	Face height (Childata: 17) The vertical distance of the face from the crinion (the top of the brow) to the menton (the bottom of the chin). The subjects sit erect with head oriented in the Frankfurt plane (looking straight ahead) and arms hanging at sides. <i>Instrument: Sliding caliper</i>	
18	Face length (menton-sellion) (EN ISO 7250-1:2017, 6.3.11) — Childata: 18 Distance between sellion and menton. Subject keeps mouth closed. Head is oriented in the Frankfurt plane. <i>Instrument: Sliding caliper</i>	
19	Mouth breadth (Childata: 22) With the mouth relaxed the horizontal distance between the angles of the mouth at the point where the mucous membrane joins the skin.	
20	Mouth opening (between incisors) (Childata: 23) The maximum vertical distance measured between the incisors (front teeth) with the jaws open as wide as possible.	

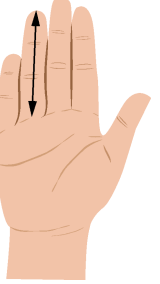
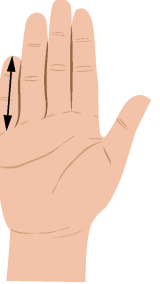
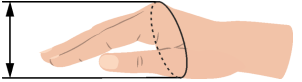
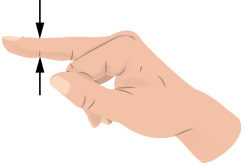
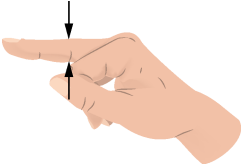
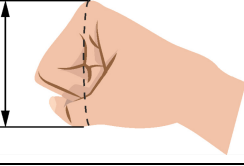
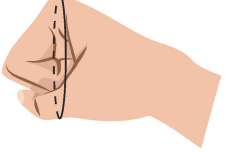
Table A.2 — Hand

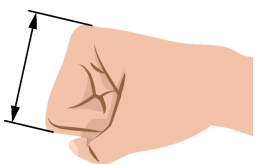
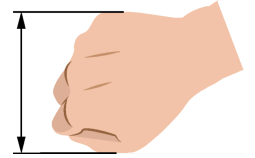
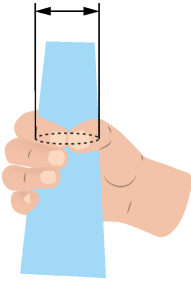
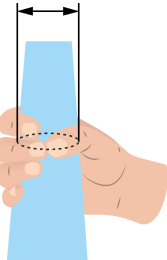
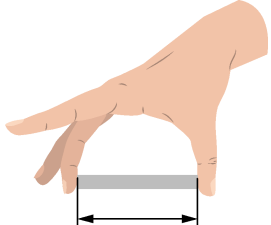
Hand		
1	Hand length (stylion) (EN ISO 7250-1:2017, 6.3.1 — ISO 8559-1:2017, 5.5.2) The distance from the tip of the middle finger, along its long axis, to a line connecting the radial and ulnar styloid processes. Subject holds the forearm horizontal with hand stretched out flat, palm up. The point of measurement at the styloid process corresponds approximately to the middle skin furrow of the wrist. <i>Instrument:</i> Sliding caliper.	
2	Palm length (EN ISO 7250-1:2017, 6.3.2 — ISO 8559-1:2017, 5.5.3) The distance from the midpoint of the proximal crease at the base of the middle finger to the most distal wrist crease. Subject holds forearm horizontal with hand stretched out flat, palm up. <i>Instrument:</i> Sliding caliper.	
3	Hand length (to thumb crotch) (Childata: 72) The distance from the crotch of the thumb to the tip of the middle finger. The subject extends the right hand with the palm up and thumb away (abducted) from hand.	
4	Hand breadth at metacarpals (EN ISO 7250-1:2017, 6.3.3) Projected distance between radial and ulnar metacarpals at the level of the metacarpal heads from the second to the fifth metacarpal, measured perpendicular to the long axis of the middle finger. Subject holds forearm horizontal with hand stretched out flat, palm up. <i>Instrument:</i> Large sliding caliper	
5	Hand breadth at thumb (Childata: 75) The maximum distance across the hand and thumb at the level of the middle joint of the thumb. The subject extends the hand and the thumb is held against the side of the palm.	

Hand		
6	Hand girth (ISO 8559-1:2017, 5.5.1) Maximum girth over the knuckles (metacarpals). Subject holds forearm horizontal with hand outstretched, fingers extended, and thumb abducted. <i>Instrument: Tape measure</i>	
7	Thumb breadth at distal joint (Childata: 85) The maximum breadth measured across the distal joint of the thumb.	
8	Index finger breadth, distal (EN ISO 7250-1:2017, 6.3.6) Maximum breadth of the second finger in the region of the joint between middle and distal phalanges. Subject holds the forearm horizontal with hand stretched out flat and fingers spread, palm up. <i>Instrument: Sliding caliper</i>	
9	Index finger breadth, proximal (EN ISO 7250-1:2017, 6.3.5) Maximum breadth of the second finger in the region of the joint between middle and proximal phalanges. Subject holds forearm horizontal with hand stretched out flat and fingers spread, palm up. <i>Instrument: Sliding caliper.</i>	
10	Middle finger breadth at distal joint (Childata: 97) The maximum breadth measured across the distal (furthest) joint of the middle finger.	

Hand		
11	Middle finger breadth at middle joint (Childata: 98) The maximum breadth measured across the middle joint of the middle finger.	
12	Fourth finger breadth at distal joint (Childata: 103) The maximum breadth measured across the distal (furthest) joint of the fourth finger.	
13	Fourth finger breadth at middle joint (Childata: 104) The maximum diameter measured across the middle joint of the fourth finger.	
14	Little finger breadth at distal joint (Childata: 106) The maximum diameter measured across the distal joint of the little finger.	
15	Little finger breadth at middle joint (Childata: 107) The maximum breadth measured across the proximal joint of the little finger.	

Hand		
16	Middle finger length (distal joint to tip) (Childata: 94) The distance from the centre of the distal (end or furthest) joint to the tip of the middle finger, measured in the palm of the hand with the hand fully extended.	
17	Middle finger length (middle joint to distal joint) (Childata: 95) The distance from the centre of the middle joint to the centre of the distal (end or furthest) joint of the middle finger, measured in the palm of the hand with the hand fully extended.	
18	Thumb length (Childata: 85) The distance from the skin crease at the base of the thumb to the tip of the thumb parallel to the long axis of the thumb. The subject extends the right hand and fingers with the palm facing up and the thumb away (abducted) from hand. Measurement is taken on the palmar surface of the hand.	
19	Index finger length (EN ISO 7250-1:2017, 6.3.4) The distance from the tip of the second finger to the proximal finger crease on the palm of the hand. Subject holds forearm the horizontal with the hand stretched out and fingers spread, palm up. Measurement is taken on the palmar surface of the hand. <i>Instrument: Sliding caliper</i>	
20	Middle finger length (Childata: 93) The distance from the skin crease at the base of the middle finger to the tip of the middle finger parallel to the long axis of the middle finger. The subject extends the right hand and fingers with the palm facing up. Measurement is taken on the palmar surface of the hand.	

Hand		
21	Fourth finger length (Childata: 102) The distance from the skin crease at the base of the fourth finger to the tip of the fourth finger parallel to the long axis of the fourth finger. The subject extends the right hand and fingers with the palm facing up. Measurement is taken on the palmar surface of the hand.	
22	Little finger length (Childata: 105) The distance from the skin crease at the base of the little finger to the tip of the little finger parallel to the long axis of the little finger. The subject extends the right hand and fingers with the palm facing up. Measurement is taken on the palmar surface of the hand.	
23	Hand depth (Childata: 76) The maximum distance between the palm of the hand and the dorsum of the hand at the level of the metacarpal joint (the first or largest knuckle) of the middle finger.	
24	Hand clearance (maximum aperture) (Childata: 78) The subject extends the right hand and holds the fingers together to form its narrowest configuration. With a hand measurement board, the smallest diameter through which the hand can just pass without forcing it.	
25	Middle finger depth at distal joint (Childata: 99) The maximum depth of the middle finger at the distal joint measured from the dorsum to the palm of the finger.	
26	Middle finger depth at middle joint (Childata: 100) The maximum depth of the middle joint of the middle finger, measured from the dorsum to the palm of the finger.	
27	Fist depth (Childata: 83) The maximum depth of the fist of the hand between the (largest) knuckles and thumb. The subject forms a fist with the right hand with the thumb lying across the fingers.	
28	Fist circumference (Childata: 84) The maximum circumference of the fist by passing a tape over the thumb and across the knuckles. The subject forms a fist with the right hand with the thumb lying across the fingers.	

Hand		
29	Middle finger length (knuckle to middle joint, hand clenched) (Childata: 96) The subject makes a fist with the right hand and the maximum distance from the furthest edge of the middle joint to the furthest edge of the largest knuckle of the middle finger is taken.	
30	Fist breadth (Childata: 82) The maximum breadth across the fist of the hand at the level of the first (or largest) knuckles of the hand and thumb. The subject forms a fist with the right hand with the thumb lying across the fingers.	
31	Maximum grip diameter (between thumb and index finger) (Childata: 79) The diameter of the cone at the level of the tip of the thumb and index finger. The subject grips a graduated cone and slides the hand down the cone until the maximum diameter that can be gripped (with thumb and index finger touching) is reached.	
32	Maximum grip diameter (between thumb and middle finger) (Childata: 80) The diameter of the cone at the level of the tip of the thumb and middle finger. The subject grips a graduated cone and slides the hand down the cone until the maximum diameter that can be gripped (with thumb and middle finger touching) is reached.	
33	Grip length (middle finger to thumb) (Childata: 81) The distance between the middle portion of the middle finger and thumb keeping the middle portions of these digits' parallel is measure. The subject grasps the faces of a grasping gauge with the right hand and the measurement is taken in the step of the gauge where the child is able to hold it comfortably.	
34	Thumb diameter (minimum aperture) (Childata: 87) With a finger measurement board, the greatest diameter through which the end or furthest joint of the thumb cannot pass. The subject extends the thumb of the right hand.	
35	Index finger diameter (minimum aperture) (Childata: 91) With a finger measurement board, the maximum diameter through which the distal joint of the index finger cannot pass. The subject extends the index finger of the right hand.	
36	Middle finger diameter (minimum aperture) (Childata:101) With a finger measurement board, the maximum diameter through which the distal joint of the middle finger cannot pass. The subject extends the middle finger of the right hand.	

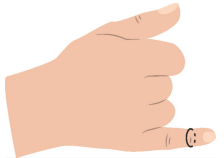
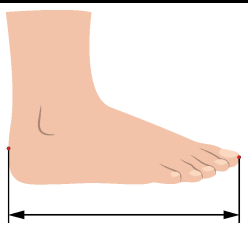
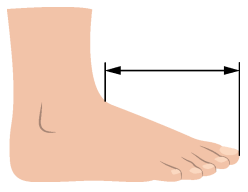
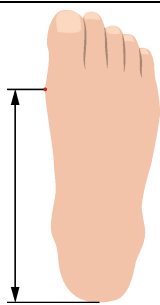
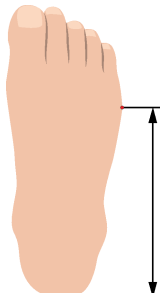
Hand		
37	Little finger diameter (minimum aperture) (Childata: 108) With a finger measurement board, the maximum diameter through which the distal joint of the little finger can just pass. The subject extends the little finger of the right hand.	

Table A.3 — Foot

Foot		
1	Foot length (EN ISO 7250-1:2017, 6.3.7 — ISO 8559:2017, 5.5.5) Maximum horizontal distance from rear of the heel to tip of the longest (first or second) toe, measured parallel to the longitudinal axis of the foot. Subject stands with weight equally distributed on both feet. <i>Instrument: Spreading caliper.</i>	
2	Forefoot length The horizontal distance from the tip of the longest toe (first or second) to the top of the instep, at the junction of the lower leg and foot, measured parallel to the longitudinal axis of the foot. Subject stands with weight equally distributed on both feet. <i>Instrument: Spreading caliper.</i>	
3	Distance heel — 1st metatarsal Distance, along the longitudinal axis of the foot, from the rear of the heel to the head of the first metatarsal. Subject stands with weight equally distributed on both feet.	
4	Distance heel — 5th metatarsal Distance, along the longitudinal axis of the foot, from the rear of the heel to the head of the fifth metatarsal. Subject stands with weight equally distributed on both feet.	
5	Toes width The distance between medial and lateral surfaces of the toes, perpendicular to the longitudinal axis of the foot. Subject stands with weight equally distributed on both feet. <i>Instrument: Spreading caliper.</i>	