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Psychometric performance and population norms for generic preference-accompanied health-related quality of life measures in Hungary

PhD thesis

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List of abbreviations

AQLQ – Asthma Quality of Life Questionnaire
AQoL – Assessment of Quality of Life
BMI – Body mass index
CADTH – Canadian Agency for Drugs and Technologies in Health
CI – Confidence interval
COVID-19 – Coronavirus disease 2019
cTTO – Composite time trade-off
CUI – Cancer Utility Index
DCE – Discrete choice experiment
DLQI – Dermatology Life Quality Index
DQOL – Diabetes Quality of Life Measure
DSM-5 – Fifth edition of the Diagnostic and Statistical Manual of Mental Disorders
DUI – Diabetes Utility Index
EHIS – European Health Interview Survey
EQ VAS – EuroQol Visual Analogue Scale
EQ-5D-5L – five-level EQ-5D
EQ-VT – EuroQol Valuation Technology
ES – Effect size
H′ – Shannon's index
HRQoL – Health-related quality of life
HTA – Health technology assessment
HUI – Health Utilities Index
ICC – Intraclass correlation coefficient
ICECAP-O – ICEpop CAPability measure for Older people
J′ – Shannon's Evenness index
KHQ – King's Health Questionnaire
LS – level score
MIDAS – Migraine Disability Assessment
MOS – Medical Outcomes Study
NHP – Nottingham Health Profile
NICE – National Institute for Health and Care Excellence
NNGYK – Nemzeti Egészségügyi és Gyógyszerészeti Központ (National Centre for Public Health and Pharmacy)
PAM – Preference-accompanied measure
PBAC – Pharmaceutical Benefits Advisory Committee
PROMIS – Patient-Reported Outcomes Measurement Information System
PROMIS-29+2 – Patient-Reported Outcomes Measurement Information System 29+2
PROPr – Patient-Reported Outcomes Measurement Information System-Preference Scoring system
QALY – Quality-adjusted life year
QoL – Quality of life
QOL-ACC – Quality of Life - Aged Care Consumers
QWB – Quality of Well-Being Scale
RE – Relative efficiency
SD – Standard deviation
SF-36 – 36-item Short Form
SF-6D – Short Form 6 Dimension
SGRQ – St. George's Respiratory Questionnaire
SIP – Sickness Impact Profile
UK – United Kingdom
US – United States
VAS – Visual analogue scale
WHO – World Health Organization
WHOQOL-BREF – WHO Quality of Life-BREF

1 Introduction

1.1 Health status, quality of life and health-related quality of life

Understanding health, quality of life (QoL), and health-related quality of life (HRQoL) is pivotal in grasping human experiences, perceptions, expectations, and beliefs, especially in the context of healthcare. Although closely related, these terms refer to different dimensions of an individual's life (1).

The World Health Organization (WHO) defines health as *"a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity"* (2). This comprehensive definition underlines the complexity of health, incorporating physical, mental, and social dimensions, which are central to understanding QoL and HRQoL. Physical health refers to the proper functioning of bodily systems, mental health concerns cognitive and emotional functioning, and social health pertains to interpersonal relationships and social interactions (1).

QoL is a broad, multidimensional concept encompassing an individual's overall life satisfaction, sense of fulfilment, and ability to function daily. It is inherently subjective, shaped by personal perceptions, expectations and experiences, yet also influenced by objective factors such as socioeconomic background and social environment (3, 4). QoL reflects a wide range of elements, including emotional stability, independence, social relationships, and personal beliefs, with considerable variation depending on personal values and cultural context.

HRQoL serves as a bridge between health and QoL by focusing on how health status affects an individual's capacity to lead a fulfilling life. Unlike the broader QoL, HRQoL targets the impact of diseases and treatments on physical, psychological, and social functioning. Although HRQoL lacks a precise definition in the literature, it is a critical construct in healthcare settings, providing insights into the burden of diseases and the effectiveness of medical interventions from the patient's perspective (4-6).

The interrelationship between health, QoL, and HRQoL is intricate (1). By distinguishing between these concepts, healthcare professionals can better understand different facets of an individual's experiences and design more targeted interventions. Given its relevance in the medical field, this thesis centres on HRQoL, aiming to evaluate how health

conditions directly affect daily functioning and specific aspects of QoL, offering critical insights for assessing medical interventions and guiding healthcare decisions, ensuring that treatments are evaluated from the patient's perspective.

1.2 The concept of utility and its measurement methods

In health interventions, it is essential to assess the patient's HRQoL and prioritise which health states are better or worse. Following such interventions, patients often transition from one health state to another. To evaluate the impact of these interventions, it is important to know which state is preferred. However, simply ranking health states is insufficient for determining which intervention will yield the greatest health gain. In health economics, utility is used to measure these preferences, reflecting the HRQoL associated with each state. Utilities are conventionally expressed on a cardinal scale where perfect health is anchored at 1 and 0 is equivalent to being dead. Notably, some states may be considered worse than being dead and are assigned negative values between 0 and minus infinity (7-9).

The utility of health states can be measured through direct and indirect methods. Direct methods, such as the standard gamble and time trade-off, require individuals to make explicit choices that reflect their preferences for different health states (10). Indirect methods rely on standardised HRQoL measures (e.g., EQ-5D), where respondents complete questionnaires, and their responses are converted into utility values using pre-established preference weights (i.e., value sets) (11).

1.3 Quality-adjusted life years

To effectively evaluate the trade-offs between costs and health gains in cost-utility analyses of health interventions, it is essential to consider both the quantity and quality of life. The quality-adjusted life year (QALY) provides a comprehensive metric for this purpose by integrating mortality (quantity of life) and morbidity (quality of life). A QALY is calculated by multiplying the utility value of a person's health state by the time (in years) spent in that state. For instance, one year in perfect health is equal to 1 QALY, while 10 years in a health state valued at 0.1, or 10 individuals each spending one year in such state, would also equal 1 QALY (12, 13).

Despite its widespread use, QALY has faced methodological and ethical debates (14, 15). Methodologically, challenges include the subjective nature of HRQoL assessments, variability in utility elicitation methods, and the influence of discount rates on long-term benefits. Ethically, QALYs may disproportionately favour younger individuals or those without disabilities, potentially conflicting with equity principles. Additionally, QALY does not account for whether health gains affect one individual or many people marginally, nor do they distinguish between improvements in varying severities of health (14, 15). Nonetheless, QALY remains a cornerstone of health economics, playing a crucial role in cost-utility analyses and guiding decision-making in allocating healthcare resources in many countries (12, 13). For instance, the National Institute for Health and Care Excellence (NICE) in England and Wales (16), the Canadian Agency for Drugs and Technologies in Health (CADTH) (17), and Australia's Pharmaceutical Benefits Advisory Committee (PBAC) (18) use QALYs to fund treatments. Hungary's National Centre for Public Health and Pharmacy (Nemzeti Egészségügyi és Gyógyszerészeti Központ, NNGYK) also employs QALYs to determine medication reimbursement (19).

1.4 HRQoL measures

HRQoL measures are crucial in healthcare and research for evaluating and assessing an individual's health. These measures offer valuable insights into the effectiveness of treatments, the impact of diseases, and the general health of populations. They can be broadly categorised into generic vs. condition-specific and preference-accompanied vs. non-preference-accompanied measures (20, 21).

Generic HRQoL measures are versatile tools used across various populations and health conditions. They enable comparisons of HRQoL across diseases, conditions, and treatments, making them common in population health surveys and large-scale epidemiological studies. These measures assess physical, mental, and social functioning, providing a comprehensive health overview. In contrast, condition-specific measures focus on particular diseases or conditions, offering greater sensitivity to changes related to specific health issues. This makes them valuable in clinical trials and studies targeting specific patient groups, as they provide detailed insights that inform treatment and management strategies (22, 23).

Preference-accompanied measures (PAMs) provide a single summary index value representing overall HRQoL by combining various health domains. This simplifies data interpretation and communication with stakeholders like policymakers and clinicians and is crucial for calculating QALYs in cost-utility analyses (24). Non-preference-accompanied measures describe HRQoL across multiple domains, each scored separately. While this detailed view highlights specific areas of HRQoL, the multiple scores can make interpretation more complex. However, detailed information is essential for personalised care and tailored interventions (20, 21).

To illustrate these concepts, consider the following examples. Generic PAMs include the EQ-5D, Health Utilities Index (HUI), Short Form 6 Dimension (SF-6D), Quality of Well-Being Scale (QWB), and the Assessment of Quality of Life (AQoL) (25-30). For condition-specific PAMs, examples include the Diabetes Utility Index (DUI), the NEWQOL-6D, the King's Health Questionnaire (KHQ) and the Cancer Utility Index (CUI) (31-35). Generic non-preference-accompanied measures include the 36-item Short Form (SF-36), the WHO Quality of Life-BREF (WHOQOL-BREF), the Nottingham Health Profile (NHP), and the Sickness Impact Profile (SIP) (36-39). Examples of condition-specific non-preference-accompanied measures include the Dermatology Life Quality Index (DLQI), the Diabetes Quality of Life Measure (DQOL), the Migraine Disability Assessment (MIDAS), the St. George's Respiratory Questionnaire (SGRQ), and the Asthma Quality of Life Questionnaire (AQLQ) (40-44).

HRQoL measures–whether generic or condition-specific, preference-accompanied or not–play a vital role in understanding the multifaceted nature of health (20, 21). Choosing the appropriate measure allows healthcare professionals and researchers to effectively assess health outcomes, guide treatment decisions, and enhance patient care.

1.5 Generic PAMs in this thesis

This thesis focuses on four key generic PAMs: the EQ-5D-5L, 15D, PROPr and SF-6D. Each PAM provides unique insights into HRQoL and is integral for comparing interventions across different contexts. In this thesis, the term “index value” will be used to describe the quantified measure of HRQoL, following EQ-5D terminology (45). While the broader health economics literature often uses the term “utility”, given that generic

preference-accompanied measures lie in the focus of this thesis, adopting "index value" ensures consistency with the specific terminology used in EQ-5D-based studies.

1.5.1 EQ-5D-5L

Developed by the EuroQol Group in the late 1980s, the EQ-5D is currently the most widely used PAM internationally (46, 47). Initially, it included three response levels per domain (EQ-5D-3L) (25), which was later expanded to five response levels (EQ-5D-5L) (26), enhancing its measurement properties (48).

The EQ-5D-5L comprises a descriptive system and a visual analogue scale called EQ VAS. The EQ VAS is a 20-centimetre-long vertical "health thermometer" that allows respondents to rate their health on a scale from 0 (the worst health you can imagine) to 100 (the best health you can imagine). The descriptive system covers five health domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression (25, 26). Each domain contains one item with five severity levels, ranging from "no problems" to "unable to/extreme problems", resulting in a total of 3125 (5^5) unique health profiles. Respondents are asked to recall their current health ("your health today") (26).

The EQ-5D-5L is recommended by pharmacoeconomic guidelines in various countries (46) including Hungary (19), and is recognised as the preferred PAM in 15 of these guidelines (46). Over the past decades, more than 30 countries, including Hungary, have developed country-specific EQ-5D-5L value sets (49, 50). Additionally, the EQ-5D-Y-3L, the youth version of the EQ-5D for children and adolescents aged 8 to 15, has been widely adopted for assessing HRQoL in younger populations, and a Hungarian value set was developed to support its use in paediatric healthcare and research (51). The EQ-5D-5L has demonstrated robust measurement performance across a wide range of acute and chronic health conditions and diverse populations (52) and has been validated in Hungary for both the general population and various patient groups (53-62).

1.5.2 15D

The 15D, developed in the early 1970s in Finland, assesses HRQoL with an extensive, 15-dimensional descriptive system (63). While the questionnaire has been translated into 32 languages, its primary use remains in Nordic countries (64).

The 15D encompasses 15 health domains: mobility, vision, hearing, breathing, sleeping, eating, speech, excretion, usual activities, mental function, discomfort and symptoms, depression, distress, vitality, and sexual activity (63). Respondents are asked to recall their present health status on a five-point response scale for each domain. The response levels vary by domain and can be either capability scales [e.g., I can hear normally, i.e. normal speech (with or without a hearing aid). / I hear normal speech with a little difficulty. / I hear normal speech with considerable difficulty; in conversation I need voices to be louder than normal. / I hear even loud voices poorly; I am almost deaf. / I am completely deaf.] or severity scales (e.g., I have no/mild/marked/severe/unbearable physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.). Responses from the 15 domains can be combined into a 15-digit string expressing a health profile. Theoretically, the instrument can describe over 30 billion (5^{15}) health profiles.

There are four country-specific value sets available for the 15D: one for Finland (65), one for Denmark (66), and two for Norway estimated with different methods (67, 68). The 15D's validity, reliability, and responsiveness have been confirmed across numerous health conditions and populations (69-80). An official Hungarian version of the 15D is available; however, it has not yet been validated in previous research conducted in Hungary.

1.5.3 PROPr

The PROPr (Patient-Reported Outcomes Measurement Information System-Preference scoring system) is a relatively new tool designed to convert PROMIS (Patient-Reported Outcomes Measurement Information System) responses into index values. Recently, the PROMIS initiative has gained increasing attention (81). Developed using advanced psychometric methods (item response theory) in the early 2010s in the United States (82), PROMIS is based on item banks covering over 100 different health areas (83).

Among the three adult PROMIS profiles (PROMIS-57, -43 and -29), PROMIS-29 is the most widely used (81). The PROMIS-29 descriptive system encompasses seven health domains, each consisting of 4 items with 5 response levels [physical function, anxiety, depression, fatigue, sleep disturbance, ability to participate in social roles and activities (hereafter social roles), pain interference] and a 0-10 pain intensity numeric rating scale. The PROMIS-29+2 v2.1 is an extended version of the PROMIS-29, featuring an eighth

domain, cognitive function (Cognitive Function-Abilities v2.0), which includes two items (84). The response levels for each item vary across severity ("not at all" to "very much"), frequency ("never" to "always"), interference with functioning ("not at all" to "very much"), global rating ("very good" to "very poor") and capability ("without difficulty" to "unable to") format scales. Respondents are typically asked to recall their health over the past seven days, whereas the recall period is unspecified for physical function and social roles domains. By combining responses from seven PROMIS-29+2 domains (all but anxiety), it is possible to define 217,238,121 unique health profiles to which index values can be assigned (85).

To date, only one country-specific value set is available for the PROPr from the United States of America (85). The measurement properties of PROMIS-29, PROMIS-29+2 and PROPr have been evaluated in various settings, demonstrating their versatility and applicability (54, 86-89). Notably, the PROMIS-29(+2) has been previously validated in Hungary, both in a general population sample and a sample of individuals with low back pain (90, 91). Additionally, among the PROMIS questionnaires, the PROMIS Global Health has also been validated in Hungary (92).

1.5.4 SF-6D

Another widely adopted PAM is the Short-Form 6-Dimensions (SF-6D), developed in the late 1990s in the United Kingdom. It can be derived from the 36-item Short-Form (SF-36) or the 12-item Short-Form (SF-12), designed to estimate index values by capturing six domains of health (27, 36).

The SF-6D combines 11 items of six SF-36 domains (physical functioning, role limitation, social functioning, pain, mental health, and vitality) (27, 36). Thus, SF-6D comprises six domains, each represented by one item. These items have 4 to 6 response levels measuring severity ("no limitations" to "a lot of limitations"), frequency ("all of the time" to "none of the time"), or interference with functioning (e.g., "no pain" to "pain that interferes with one's normal work extremely"). This descriptive system results in a total of 18,000 unique health profiles. Respondents recall their health over 4 weeks, except for the physical functioning domain, which asks about current health ("now").

Several countries list the SF-6D as an applicable measure in their health technology assessment guidelines, alongside other options (46). To date, 12 countries have

established SF-6D value sets (93). While the SF-6D has demonstrated strong psychometric performance across multiple health conditions (94-96), unlike the EQ-5D-5L, it has not undergone extensive validation in Hungary (53, 97).

1.6 Psychometric properties of HRQoL measures

The usefulness of HRQoL measures in clinical practice, research, and health policy relies heavily on their psychometric performance. The key properties that evaluate questionnaires are validity, reliability and responsiveness (98, 99).

Validity assesses how well the questionnaire captures the concepts it is intended to measure. It is examined through three main factors: content validity, construct validity and criterion validity (98-100).

- Content validity ensures that the given questionnaire covers all relevant aspects of health and measures the intended content. Key aspects include relevance (items should address all relevant health areas), comprehensiveness (items should cover all important aspects for the target population), and comprehensibility (items should be clearly worded and easy to understand) (100).
- Construct validity reflects whether the questionnaire accurately measures the intended aspects of HRQoL and distinguishes between different groups of respondents (i.e., known-groups validity). It should also correlate well with other validated instruments measuring the same construct (i.e., convergent validity) (101, 102).
- Criterion validity involves comparing the measure to an external "gold" standard. However, for generic PAMs, there is no established benchmark or gold standard to compare against. Therefore, while criterion validity is crucial when such a standard exists, it is not applicable in the case of generic PAMs (101, 102).

Reliability refers to the consistency of an HRQoL measure. A reliable measure produces consistent results under similar conditions. Types of reliability include test-retest reliability, which assesses the stability of a measure over time, and internal consistency, which examines whether items within a subscale are measuring the same underlying concept. Internal consistency is particularly relevant for instruments like PROMIS, where multiple items are used to measure a single domain. However, for measures like the EQ-

5D, where each item is designed to assess distinct HRQoL domains, internal consistency is inapplicable as the items represent independent constructs (101, 102).

Responsiveness (or sensitivity) reflects the questionnaire's ability to detect significant changes in HRQoL over time. A responsive measure can accurately capture the effects of an intervention or disease progression (101-103).

These properties ensure that HRQoL measures are robust, guiding clinical decisions and shaping health policies (98, 99). While longitudinal surveys are essential for assessing reliability and responsiveness, validity can also be evaluated through cross-sectional surveys.

1.7 Population norms

Population norms, also known as population reference data, are essential in interpreting responses on HRQoL measures. They provide a framework for comparing the HRQoL of individuals or patient groups to that of a reference group, most commonly a representative sample general population, considering factors such as age and gender (104).

Population norms are essential in healthcare and research by enabling clinicians to track changes in the general population's HRQoL over time, detect emerging health trends, and highlight areas of inequality (104-107). These norms provide a benchmark for comparing individual patient HRQoL, serving as a reference to assess treatment efficacy and monitor health improvements. Such comparisons can reveal unmet healthcare needs within specific demographics or geographic regions, enabling policymakers to target interventions effectively and allocate resources where they are most needed. Ultimately, utilising population norms drives the development of strategies aimed at reducing inequalities and enhancing overall public health.

The EQ-5D and SF-6D have well-established population norms across various countries (108), including Hungary. Hungarian EQ-5D-3L population norms were first developed over two decades ago (109) and have recently been updated (110). However, Hungarian population norms remain limited to summary or T-scores of the SF-36 (111) and two PROMIS generic health status measures (PROMIS-29+2 and PROMIS Global Health) (90, 92). Notably, population normative values for measures such as the 15D or PROPr have yet to be developed in any country. With new measures emerging and health

dynamics shifting due to factors such as economic changes and public health crises like COVID-19, the need for up-to-date norms that accurately reflect current HRQoL and capture the evolving health landscape has become increasingly urgent.

2 Objectives

1. Comparison of EQ-5D-5L and 15D study

The EQ-5D-5L is a widely validated instrument, including in Hungary, where it is extensively used across various conditions (53-62). However, it may not fully capture all relevant HRQoL aspects, particularly in sensory and mental health conditions (94, 112). In contrast, the 15D offers a more comprehensive descriptive system, which could present certain advantages. Notably, the 15D has not been validated in Hungary, highlighting a key rationale for further research. This study aimed to:

- compare the measurement performance of the EQ-5D-5L and 15D both at the level of descriptive systems and index values in terms of ceiling and floor, informativity, agreement, redistribution properties, convergent and known-groups validity.

2. 15D population norms study

The 15D is a comprehensive PAM for assessing a wide range of HRQoL areas, offering a strong basis to describe the general population's HRQoL. However, 15D population norms have not been established in any country. Thus, this study aimed to:

- establish Hungarian population norms for the 15D by gender and age;
- assess the association of index values with sociodemographic factors (e.g., gender, age), and several chronic physical and mental health conditions;
- provide index value estimates for a wide array of prevalent chronic diseases.

3. EQ-5D-5L, PROPr and SF-6D population norms study

The EQ-5D-5L, PROPr and SF-6D measure similar health constructs; however, each was developed using different approaches and has varying characteristics, which makes it important to understand how these PAMs differ in describing the population's HRQoL. This study aimed to:

- develop Hungarian population norms for the EQ-5D-5L, PROPr and SF-6D;
- compare HRQoL across these three instruments;
- explore the association of index values with sociodemographic and health-related variables.

3 Methods

This chapter draws upon three published articles of the candidate:

1. **Nikl A,** Janssen MF, Brodszky V, Rencz F. A head-to-head comparison of the EQ-5D-5L and 15D descriptive systems and index values in a general population sample. Health Qual Life Outcomes. 2023;21(1):17.
2. **Nikl A,** Janssen MF, Brodszky V, Rencz F. Hungarian population norms for the 15D generic preference-accompanied health status measure. Qual Life Res. 2024;33(1):87-99.
3. **Nikl A,** Janssen MF, Jenei B, Brodszky V, Rencz F. Population Norms for the EQ-5D-5L, PROPr and SF-6D in Hungary. Pharmacoeconomics. 2024;42(5):583-603.

3.1 Comparison of EQ-5D-5L and 15D study

3.1.1 Study design and survey content

A cross-sectional survey was conducted with a targeted sample size of 2000 members of the Hungarian adult general population (response rate 77.8%). The broader aim of the survey was to assess the mental health of the population. Permission for conducting the study was granted by the Research Ethics Committee of the Corvinus University of Budapest (no. KRH/166/2021). Participants were recruited in August 2021 from one of the largest available online panels in Hungary by a third-party survey company. Respondents registered voluntarily to complete surveys in return for points, which could be redeemed for rewards. Respondents were included who were at least 18 years old at the time of completion, gave informed consent, and confirmed that they had understood the terms and were willing to participate. “Soft” quotas were applied to ensure the representativeness of the sample for the general population by age, gender, the highest level of education, geographical region, and settlement type.

A self-administered survey was designed for the study that asked questions about HRQoL, well-being, presence of physical and mental health conditions, resource utilization related to mental health care, and sociodemographic characteristics. The list of the physical health conditions was selected according to the 2019 Hungarian results of the European Health Interview Survey (EHIS) (113) complemented by some common

chronic diseases. Similarly, the list of mental health conditions was chosen according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (114). We asked respondents to report any physical and mental health conditions experienced in the past 12 months in two questions. Firstly, they had to state whether they had any self-reported physical or mental health conditions. Secondly, they had to mark those that were also diagnosed by a physician. The participants answered the questions in a fixed order, starting with the EQ-5D-5L and multiple questions were included between the EQ-5D-5L and 15D.

3.1.2 Outcome measures

All participants completed a set of standardised questionnaires, including the validated Hungarian versions of EQ-5D-5L and 15D. The description of the EQ-5D-5L and 15D is outlined in *Chapter 1.5*.

As a base case, we used the Danish value sets for both the EQ-5D-5L (115) and 15D (66), because currently, Denmark is the only country with national value sets for both measures. However, using these value sets may have limitations. They were developed in different decades, using different preference elicitation methods, and thus have largely different value set ranges. Furthermore, using Danish value sets for Hungary may also pose additional problems given the differences in sociodemographic and economic characteristics and cultural values between the two countries (116). Therefore, to test the robustness of our results, we repeated all analyses using the Hungarian EQ-5D-5L (50) and Norwegian 15D value sets (68). The former was selected because of the study country, while the latter was considered as the most recently developed 15D value set with a similar value set range to the Hungarian EQ-5D-5L value set.

3.1.3 Statistical analysis

Our analytical framework builds on previous studies that compared the measurement properties of other generic PAMs (117-120). As a result of a technical problem in the online survey interface, a few respondents' EQ-5D-5L responses may have been inadvertently recorded as level 5 responses. Therefore, the research team examined all level 5 responses attentively in the EQ-5D-5L and compared them with other information (i.e., self-reported HRQoL on other measures, physician-diagnosed physical and mental

health conditions) provided by the respondents. As a result, 113 participants were excluded from the sample before the statistical analysis.

To compare the two instruments, corresponding dimensions of EQ-5D-5L and 15D were matched, e.g., EQ-5D-5L mobility and 15D mobility. All analyses were performed on the total sample, and also for two subsets of respondents: (i) respondents with physical health conditions, and (ii) respondents with mental health conditions. Statistical analyses were performed using R Statistical Software (version 4.1.1; R Foundation for Statistical Computing, Vienna, Austria). All the statistics were two-sided, and $p<0.05$ was considered statistically significant.

The proportion of participants reporting "no problems" (ceiling) and "extreme problems" (floor) was computed for each dimension of the descriptive systems. In addition, we calculated the ceiling and floor for the EQ-5D-5L and 15D health profiles, i.e., "no problems" and "extreme problems" in all dimensions, respectively. We expected a higher overall ceiling in the EQ-5D-5L than the 15D at an instrument level since the descriptive system of the latter is more detailed (121).

The informativity of EQ-5D-5L and 15D dimensions, index values, and health state profiles was examined by Shannon's (absolute informativity, H') and Shannon's Evenness (relative informativity, J') indices (122, 123). The Shannon index (H') can be defined as $H' = -\sum_{i=1}^{L} p_i * \log_2 p_i$, where p_i is the proportion of observations in the *i*th level (where i = 1, …, L), and L is the number of levels in a dimension of the descriptive system. The greatest amount of information can be gathered if the responses are equally used across the levels. The Shannon Evenness index (J′) measures the evenness of distribution and was calculated as $J' = \frac{H'}{H'_{max}} = \frac{-\sum_{i=1}^{L} p_i * \log_2 p_i}{\log_2 L}$. Thus, H' ranges from 0 to $\log_2 L$, and J' ranges from 0 to 1, where a higher value indicates better informativity.

We performed cross-tabulations of the corresponding EQ-5D-5L and 15D dimensions to explore how consistent the responses were. We considered an EQ-5D-5L and 15D response pair inconsistent if the 15D response was at least two levels away from the EQ-5D-5L response (124). The average size of inconsistencies was assessed according to the following weights: 0 if EQ-5D-5L and 15D responses did not differ more than 1 level, 1 if responses differed by 2 levels, and so forth (124).

The agreement between the EQ-5D-5L and 15D index values was examined using intraclass correlation coefficient (ICC) (125) and Bland-Altman plot (126). A two-way random model with absolute agreement was applied to obtain an ICC value (127). Agreement was considered poor $0 \leq ICC < 0.4$, fair $0.4 \leq ICC < 0.6$, good $0.6 \leq ICC < 0.75$, and excellent $0.75 \leq ICC < 1$ (128).

We examined the convergent validity between the EQ-5D-5L and 15D dimensions (Spearman's correlation) and index values (Pearson's correlation). The absolute value of the correlation coefficient (r) was interpreted as follows: very weak correlation $|r| < 0.2$, weak correlation $0.2 \leq |r| < 0.4$, moderate correlation $0.4 \leq |r| < 0.6$ and strong correlation $0.6 \leq |r| \leq 1$ (129). We expected higher correlations among the corresponding dimensions covering similar aspects of health (70).

Known-groups validity was evaluated for self-reported physician-diagnosed health condition groups in contrast to being healthy. We hypothesised that respondents with a diagnosed physical or mental condition had significantly lower EQ-5D-5L and 15D index values. Student's t-test was used to compare the healthy and non-healthy groups. Effect size (ES, Cohen's d) and relative efficiency (RE) were calculated. ES values were interpreted as negligible $d < 0.2$, small $0.2 \leq d < 0.5$, medium $0.5 \leq d < 0.8$, and large $0.8 \leq d$ (130). The RE was calculated as the ESs ratio of the two indices, where the 15D test statistic was used as reference; thus, an $RE > 1$ indicated that the EQ-5D-5L was more efficient in discriminating between two subgroups. To test whether the RE statistically differs from 1, 95% confidence intervals were calculated using 2000 bootstrap samples with accelerated bias correction.

3.2 15D population norms study

3.2.1 Study design and survey content

The cross-sectional data used in this study are the same as in the "*Comparison of EQ-5D-5L and 15D"* study (see *Chapter 3.1.1* for detailed information). However, due to a technical issue affecting only EQ-5D-5L responses, 113 participants were excluded from that analysis, reducing the sample size from 2000 to 1887. Since the 15D data were unaffected, the current study retains the full sample of 2000 participants.

3.2.2 15D

Participants completed a self-administered online survey comprising a selection of standardised questionnaires, including the validated Hungarian version of the 15D. The instrument is described in detail in *Chapter 1.5.2*.

To calculate the 15D index values, we used the Norwegian value set (68). The index values of the Norwegian value set range from -0.516 to 1, where negative values describe health states worse than dead. The Norwegian value set was selected as it is the most recently developed one that compared to previous 15D valuation studies, benefited more from the most recent valuation and modelling advancements.

3.2.3 Statistical analysis

The relative frequency of responses on each response level of each domain was calculated for the total sample and stratified by gender and age groups. We dichotomised responses ("no problems" or "any problems") in each domain, then used Pearson's χ^2 tests to detect any differences between the frequency of respondents across these subgroups.

Mean level scores (LS) were also calculated to summarise the responses on each 15D domain according to gender and age groups. To compute LS, we transformed 1 to 5 responses on each domain to a 0-100 scale, where higher scores indicate worse HRQoL (131). Mean and 95% confidence intervals were computed for the 15D index values. Both for LS and index values, differences between sociodemographic subgroups were examined by Student's t-test and analysis of variance, where applicable. Mean index values were calculated for 32 physical and 24 mental health condition groups.

Multivariate linear regressions were used to explore the association of sociodemographic and health-related variables with the 15D index values. Homoskedasticity was evaluated by the Breusch-Pagan test. In case heteroskedasticity was present in the model, a correction using robust standard errors was performed. Gender, age, highest level of education, settlement type, geographical region, employment status, marital status, household's per capita net monthly income, and physical and mental health conditions with a sample size of at least 30 cases were included in the models as independent variables. All independent variables were categorical. The household's per capita net monthly income was split according to the median income level (112,500 HUF).

All statistical analyses were carried out using R Statistical Software (version 4.1.1; R Foundation for Statistical Computing, Vienna, Austria). All statistics were two-sided, and the significance level was set at 0.05.

3.3 EQ-5D-5L, PROPr and SF-6D population norms study

3.3.1 Study design and survey content

A cross-sectional online survey was administered involving the Hungarian adult general population aiming for a sample size of 1700 (54, 90, 92, 132, 133). Participants were recruited by a panel company in November 2020 and received survey points upon completing the questionnaire which could be redeemed for rewards. “Soft” quotas were set to obtain a broadly representative sample of the Hungarian population in terms of age, gender, education, place of residence and geographical region (134). The Research Ethics Committee of the Corvinus University of Budapest granted permission to conduct the survey (no. KRH/343/2020).

Sociodemographic (age, gender, education, place of residence, geographical region, employment, marital status, income) and health-related information (height, weight, self-perceived health, providing informal caregiving, exercising, smoking, alcohol consumption, prescription or over-the-counter medication use and the history of physician-diagnosed chronic conditions) were also collected. The respondents' chronic health conditions were recorded in two steps. Firstly, respondents were asked to indicate any experienced chronic health conditions or chronic consequences of acute conditions in the last 12 months, then they were required to mark those that had been diagnosed by a physician. The list of health conditions was compiled based on the EHIS with the addition of some other conditions common in the general population (113). Respondents were asked to estimate the time spent on sports or physical work each week in hours and minutes and share the number of medications regularly taken. There were no missing data as answering all questions was mandatory.

3.3.2 Outcome measures

Respondents completed the Hungarian versions of EQ-5D-5L, PROMIS-29+2 v2.1 and SF-36v1 in a fixed order. These PAMs are presented in detail in *Chapter 1.5*, with the main characteristics of their descriptive systems and value sets summarised in Table 1.

Table 1. Comparison of the descriptive systems and value sets of the three preference-accompanied measures (135)

	EQ-5D-5L	PROPr (based on PROMIS-29+2)	SF-6Dv1 (based on SF-36 MOS)
Descriptive system			
Number of domains	5	7	6
Domains	Mobility Self-care Usual activities Pain/discomfort Anxiety/depression	Physical Function Depression Fatigue Sleep Disturbance Ability to Participate in Social Roles and Activities Pain Interference Cognitive Function	Physical functioning Role limitations Social functioning Pain Mental health Vitality
Number of items per domain	1	4	1
Number of response levels per item	5	5	4/5/6
Response scale	Severity	Severity/frequency/ interference with functioning/ global rating/capability	Severity/frequency/ interference with functioning
Recall period	Today	Past 7 days/unspecified	Now/4 weeks
Total number of health states	3125	217,238,121	18,000
Value set			
Country of origin	Hungary	US	UK
Valuation technique	composite time trade-off (EQ-VT 2.1)	standard gamble	standard gamble
Value set range	-0.848 to 1	-0.022 to 0.954	0.301 to 1

EQ-VT = EuroQol Valuation Technology; MOS = Medical Outcomes Study; PROMIS = Patient-Reported Outcomes Measurement Information System; PROPr = PROMIS-Preference scoring system; SF-36 = 36-item Short-Form; SF-6D = Short-Form 6-Dimensions

In this study, index values were computed using value sets of different nations. The Hungarian EQ-5D-5L, developed using the composite time trade-off (cTTO) method, ranges from -0.848 to 1 (50). In the absence of Hungarian value sets, we used the US PROPr value set, ranging from -0.022 to 0.954 (85), and the UK SF-6D value set, with an index value range of 0.301 to 1 (27); both developed using the standard gamble method.

3.3.3 Statistical analysis

Before the statistical analysis, data quality was assessed by the research team. Some inconsistencies were observed, indicating that certain EQ-5D-5L responses were inadvertently recorded as level 5 responses, which can be attributed to an error in the online survey interface. The research team attentively examined each level 5 response and compared them with other information provided by the respondents (e.g., self-reported health on other measures, health information and physician-diagnosed chronic health conditions). As a result, a total of 69 participants were excluded from the sample. Detailed information on the exclusion process can be found elsewhere (54).

Age was categorised into seven groups: 18-24, 25-34, 35-44, 45-54, 55-64, 65-74 and 75+ years (136). Data on sports and physical work was dichotomized using a cut-off value of 150 minutes of weekly physical activity, based on the recommendation of the World Health Organization (137). Responses on medication use were recoded into two categories: 1-4 types and 5 or more types per day (i.e., polypharmacy) (138). Respondents were asked about their height and weight, based on which body mass index (BMI) was calculated and grouped into four categories: <18.5 underweight, 18.5-24.9 normal, 25-29.9 overweight and ≥30 obese (139).

All analyses were performed for the EQ-5D-5L, SF-6D and PROPr descriptive systems and the EQ VAS. Descriptive characteristics of the sample were computed. The relative frequency of responses to each domain of each questionnaire was calculated for the entire sample and then determined according to gender and age groups. Notably, for PROMIS-29+2, T-scores were not calculated; these are presented for each domain in a previous publication (90). For all three measures, responses to each domain were dichotomized ("no problems" or "any problems"). Corresponding health domains were directly compared across the three measures (e.g., EQ-5D-5L mobility, PROPr physical function and SF-6D physical functioning). Pearson's χ^2 test was used to analyse the differences in the relative frequency of respondents with any problems among the corresponding domains of the three measures. The same test was employed to assess the differences between the responses of males and females, as well as across age groups within each domain of each measure. For each age group, the proportion of respondents in the best possible health state (i.e., no problems in any domain) was computed for all three instruments and the EQ VAS. For the latter, the maximum score of 100 represented the best possible health. This was also separately computed for males and females. Mean level scores (LS) were computed for each domain of each measure by transforming response levels to a 0-100 scale (e.g. EQ-5D-5L: level 1 = 0, level 2 = 25, level 3 = 50, level 4 = 75, level 5 = 100), where a higher score denotes a worse HRQoL (131). Student's t-test (two subgroups) or analysis of variance (three or more subgroups) was applied to test the differences between subgroup means.

Mean index values and their 95% confidence intervals were estimated for the three instruments and EQ VAS in the total sample, based on the sociodemographic characteristics and 30 chronic health condition groups reported by the respondents (e.g.,

hypertension, diabetes, musculoskeletal diseases, anxiety, depression). The differences between the mean index values of these subgroups were examined with Student's t-test or analysis of variance, where applicable.

Associations of sociodemographic and health-related characteristics of respondents with EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values were explored with multivariate linear regression models. Heteroskedasticity was evaluated by the Breusch-Pagan test and corrected using robust standard errors. The models included sociodemographic and health-related characteristics with a sample size of at least 30 cases per subgroup, as independent variables. All independent variables were categorical.

All statistical analyses were carried out using R Statistical Software (version 4.3.0; R Foundation for Statistical Computing, Vienna, Austria). All statistics were two-sided, and the significance level was set at 0.05.

4 Results

This chapter draws upon the findings of three published articles of the candidate:

1. **Nikl A,** Janssen MF, Brodszky V, Rencz F. A head-to-head comparison of the EQ-5D-5L and 15D descriptive systems and index values in a general population sample. Health Qual Life Outcomes. 2023;21(1):17.
2. **Nikl A,** Janssen MF, Brodszky V, Rencz F. Hungarian population norms for the 15D generic preference-accompanied health status measure. Qual Life Res. 2024;33(1):87-99.
3. **Nikl A,** Janssen MF, Jenei B, Brodszky V, Rencz F. Population Norms for the EQ-5D-5L, PROPr and SF-6D in Hungary. Pharmacoeconomics. 2024;42(5):583-603.

4.1 Comparison of EQ-5D-5L and 15D study

4.1.1 Characteristics of the study population

The distribution of the sample (n=1887) reasonably approximated that of the general population in terms of sociodemographics (Appendix 1). Altogether 63.4% of the sample responded that they had one or more physical conditions and 35.2% reported at least one mental health condition diagnosed by a physician.

4.1.2 Dimension-level analysis

As for the EQ-5D-5L dimensions, the floor varied between 0.2% (usual activities) and 1.2% (anxiety/depression), while the ceiling ranged from 50.8% (pain/discomfort) to 87.7% (self-care) (Table 2). Regarding the 15D dimensions, the floor reached its lowest at 0.2% (eating) and its highest at 3.9% (sexual activities), while for the ceiling, the values varied between 48.4% (sleeping) and 94.4% (eating). The EQ-5D-5L had lower ceiling in all corresponding dimension pairs, except for the EQ-5D-5L anxiety/depression vs. 15D distress pair. The highest difference in ceiling was found between EQ-5D-5L pain/discomfort (50.8%) and 15D discomfort and symptoms (68.2%). Similarly, the floor was equal or lower in the EQ-5D-5L for all pairs but EQ-5D-5L anxiety/depression vs. 15D depression. The largest difference in floor was seen between EQ-5D-5L anxiety/depression (1.2%) and 15D distress (1.7%).

Table 2. Floor and ceiling of EQ-5D-5L and 15D (140)

EQ-5D-5L							15D						
Dimensions	**Total sample (N=1887)**		**Physical conditions (N=1195)**		**Mental conditions (N=664)**		**Dimensions**	**Total sample (N=1887)**		**Physical conditions (N=1195)**		**Mental conditions (N=664)**	
	Ceiling n (%)	**Floor n (%)**	**Ceiling n (%)**	**Floor n (%)**	**Ceiling n (%)**	**Floor n (%)**		**Ceiling n (%)**	**Floor n (%)**	**Ceiling n (%)**	**Floor n (%)**	**Ceiling n (%)**	**Floor n (%)**
Mobility (walking)	1246 (66.0)	7 (0.4)	670 (56.1)	5 (0.4)	359 (54.1)	3 (0.5)	Mobility (walking, moving about)	1054 (78.0)	14 (0.7)	877 (73.4)	6 (0.5)	467 (70.3)	2 (0.3)
Self-care (washing or dressing)	1654 (87.7)	9 (0.5)	1027 (85.9)	8 (0.7)	538 (81.0)	4 (0.6)	-	-	-	-	-	-	-
Usual activities (e.g. work, study, housework, family or leisure activities)	1393 (73.8)	4 (0.2)	798 (66.8)	2 (0.2)	415 (62.5)	2 (0.3)	Usual activities (e.g. employment, studying, housework, free-time activities)	1467 (77.7)	8 (0.4)	857 (71.7)	1 (0.1)	436 (65.7)	1 (0.2)
Pain/discomfort	959 (50.8)	9 (0.5)	474 (39.7)	7 (0.6)	226 (34.0)	8 (1.2)	Discomfort and symptoms (e.g. pain, ache, nausea, itching etc.)	1287 (68.2)	9 (0.5)	719 (60.2)	2 (0.2)	355 (53.5)	4 (0.6)
Anxiety/depression	1147 (60.8)	23 (1.2)	675 (56.5)	16 (1.3)	272 (41.0)	16 (2.4)	Depression (sad, melancholic or depressed)	1295 (68.6)	21 (1.1)	777 (65.0)	12 (1.0)	343 (51.7)	10 (1.5)
							Distress (anxious, stressed or nervous)	1054 (55.9)	33 (1.7)	607 (50.8)	19 (1.6)	262 (39.5)	18 (2.7)
-	-	-	-	-	-	-	Vision (seeing and reading with or without glasses)	1360 (72.1)	17 (0.9)	812 (67.9)	5 (0.4)	408 (61.4)	6 (0.9)
							Hearing (with or without a hearing aid)	1581 (83.8)	6 (0.3)	966 (80.8)	2 (0.2)	512 (77.1)	1 (0.2)
							Breathing (breathing difficulties, shortness of breath)	1342 (71.1)	21 (1.1)	765 (60.4)	17 (1.4)	379 (57.1)	13 (2.0)
							Sleeping	921 (48.4)	14 (0.7)	491 (41.1)	9 (0.8)	225 (33.9)	9 (1.4)
							Eating	1781 (94.4)	3 (0.2)	1150 (96.2)	0 (0.0)	608 (91.6)	0 (0.0)
							Speech	1701 (90.1)	5 (0.3)	1084 (90.7)	2 (0.2)	564 (84.9)	2 (0.3)
							Excretion (bladder and bowel)	1399 (74.1)	14 (0.7)	814 (68.1)	7 (0.6)	427 (64.3)	6 (0.9)
							Mental function (thinking clearly and logically, memory)	1596 (84.6)	7 (0.4)	989 (82.8)	1 (0.1)	504 (75.9)	2 (0.3)
							Vitality (e.g. healthy and energetic, weary, tired or feeble, exhausted)	950 (50.3)	20 (1.1)	502 (42.0)	10 (0.8)	240 (36.1)	12 (1.8)
							Sexual activities	1313 (69.6)	73 (3.9)	735 (61.5)	66 (5.5)	373 (56.2)	46 (6.9)
EQ-5D-5L index value [a]	**679 (36.0)**	**0 (0.0)**	**305 (25.5)**	**0 (0.0)**	**124 (18.7)**	**0 (0.0)**	**15D index value [a]**	**396 (21.0)**	**1 (0.1)**	**147 (12.3)**	**0 (0.0)**	**67 (10.1)**	**0 (0.0)**
EQ VAS	**105 (5.6)**	**3 (0.2)**	**31 (2.6)**	**2 (0.2)**	**19 (2.9)**	**2 (0.3)**	-	-	-	-	-	-	-

[a] Note that ceiling and floor are identical regardless of the value set used.

EQ-5D-5L outperformed 15D regarding relative informativity (J') for all dimensions (ranging from 0.51 to 0.70 for the EQ-5D-5L and from 0.44 to 0.69 for the 15D), except for the EQ-5D-5L anxiety/depression (0.65) vs. 15D distress (0.69) (Table 3). Considering all dimensions of each instrument, the average J' values showed better results for the EQ-5D-5L (0.56) than for the 15D (0.49).

Responses covered all levels in both measures among the corresponding dimensions (Appendices 2-5). The rate of inconsistent response pairs ranged from 4.6% (EQ-5D-5L anxiety/depression and 15D depression) to 7.9% (EQ-5D-5L mobility and 15D mobility). The average size of inconsistency was relatively low ranging from 1.20 to 1.24.

As for the corresponding dimensions, we observed strong correlation between the EQ-5D-5L and 15D usual activities dimensions (0.619) (Table 4). The EQ-5D-5L anxiety/depression correlated stronger with 15D depression (0.690) than with 15D distress (0.642). Moderate correlation was found between the two mobility dimensions (0.558), as well as between the EQ-5D-5L dimension pain/discomfort and the 15D dimension discomfort and symptoms (0.583). The non-corresponding dimension pairs were correlated weakly to moderately, ranging from 0.115 (EQ-5D-5L mobility and 15D eating) to 0.541 (EQ-5D-5L pain/discomfort and 15D vitality). We observed moderate correlation between the EQ VAS and all EQ-5D-5L domains (except for self-care, where correlation was weak), while mostly weak and moderate connection with the 15D dimensions.

4.1.3 Analysis of the index values

The distributions of the EQ-5D-5L and 15D index values are presented in Figure 1, while the main characteristics of the indices can be found in Table 5. Overall, 270 unique health states were observed for the EQ-5D-5L and 1030 for the 15D. The most common health state profile for both instruments was full health, accounting for 36.0% of the EQ-5D-5L answers and 21.0% of the 15D answers. As for the EQ-5D-5L, the second most common profile was slight pain or discomfort with no problems on the other dimensions (6.4%), while for the 15D, slight problems with sleeping and no other problems (3.2%).

Table 3. Relative informativity of EQ-5D-5L and 15D (Shannon's Evenness index) (140)

EQ-5D-5L				15D			
Dimensions	**Total sample (N=1887)**	**Physical conditions (N=1195)**	**Mental conditions (N=664)**	**Dimensions**	**Total sample (N=2000)**	**Physical conditions (N=1195)**	**Mental conditions (N=664)**
Mobility (walking)	0.61	0.71	0.72	Mobility (walking, moving about)	0.44	0.49	0.52
Self-care (washing or dressing)	0.31	0.35	0.43	-	-	-	-
Usual activities (e.g. work, study, housework, family or leisure activities)	0.51	0.59	0.64	Usual activities (e.g. employment, studying, housework, free-time activities)	0.45	0.50	0.59
Pain/discomfort	0.70	0.76	0.81	Discomfort and symptoms (e.g. pain, ache, nausea, itching etc.)	0.55	0.61	0.69
Anxiety/depression	0.65	0.69	0.81	Depression (sad, melancholic or depressed)	0.57	0.60	0.73
				Distress (anxious, stressed or nervous)	0.69	0.71	0.82
-	-	-	-	Vision (seeing and reading with or without glasses)	0.52	0.55	0.63
				Hearing (with or without a hearing aid)	0.36	0.39	0.45
				Breathing (breathing difficulties, shortness of breath)	0.52	0.58	0.66
				Sleeping	0.70	0.74	0.82
				Eating	0.17	0.12	0.23
				Speech	0.25	0.23	0.35
				Excretion (bladder and bowel)	0.47	0.51	0.58
				Mental function (thinking clearly and logically, memory)	0.34	0.34	0.45
				Vitality (e.g. healthy and energetic, weary, tired or feeble, exhausted)	0.71	0.74	0.82
				Sexual activities	0.60	0.69	0.76
Total average	**0.56**	**0.62**	**0.68**	**Total average**	**0.49**	**0.52**	**0.61**

Table 4. Correlation coefficients between 15D and EQ-5D-5L items (140)

	EQ-5D-5L					EQ VAS	EQ-5D-5L index value (Danish)	15D index value (Danish)	EQ-5D-5L index value (Hungarian)	15D index value (Norwegian)
	Mobility	**Self-care**	**Usual activities**	**Pain/discomfort**	**Anxiety/depression**					
15D										
Mobility	**0.558**	0.459	0.534	0.405	0.220	-0.401	-0.456	-0.549	-0.490	-0.535
Vision	0.295	0.271	0.310	0.310	0.260	-0.317	-0.352	-0.511	-0.354	-0.513
Hearing	0.236	0.288	0.258	0.230	0.176	-0.239	-0.267	-0.434	-0.277	-0.430
Breathing	0.388	0.301	0.412	0.372	0.293	-0.354	-0.415	-0.627	-0.424	-0.615
Sleeping	0.280	0.209	0.311	0.446	0.431	-0.351	-0.480	-0.668	-0.464	-0.673
Eating	0.115	0.300	0.179	0.122	0.165	-0.136	-0.176	-0.346	-0.174	-0.342
Speech	0.154	0.285	0.230	0.191	0.277	-0.187	-0.267	-0.425	-0.256	-0.420
Excretion	0.274	0.229	0.296	0.340	0.264	-0.297	-0.358	-0.555	-0.358	-0.566
Usual activities	0.480	0.459	**0.619**	0.481	0.357	-0.453	-0.537	-0.643	-0.548	-0.640
Mental function	0.240	0.293	0.299	0.322	0.372	-0.266	-0.383	-0.535	-0.370	-0.528
Discomfort and symptoms	0.411	0.308	0.447	**0.583**	0.472	-0.471	-0.588	-0.708	-0.578	-0.711
Depression	0.218	0.228	0.309	0.410	**0.690**	-0.374	-0.571	-0.679	-0.519	-0.687
Distress	0.218	0.168	0.293	0.416	**0.642**	-0.363	-0.548	-0.680	-0.500	-0.702
Vitality	0.380	0.275	0.460	0.541	0.492	-0.510	-0.596	-0.782	-0.581	-0.785
Sexual activities	0.374	0.268	0.428	0.430	0.334	-0.391	-0.461	-0.632	-0.463	-0.637
EQ VAS	-0.471	-0.327	-0.474	-0.572	-0.411	-	-	-	-	-
EQ-5D-5L index value (Danish)	-0.661	-0.482	-0.663	-0.829	-0.767	0.604	-	-	-	-
15D index value (Danish)	-0.485	-0.369	-0.530	-0.629	-0.578	0.534	0.671	-	-	-
EQ-5D-5L index value (Hungarian)	-0.710	-0.516	-0.695	-0.845	-0.681	0.604	0.963	0.639	-	-
15D index value (Norwegian)	-0.479	-0.361	-0.524	-0.629	-0.586	0.542	0.671	0.998	0.638	-

Pearson's correlation coefficient was calculated for the continuous index values, while Spearman's rank correlation for the ordinal dimensions.
$p<0.05$ for all correlation coefficients (two-tailed).
Corresponding dimensions between EQ-5D-5L and 15D are in bold.

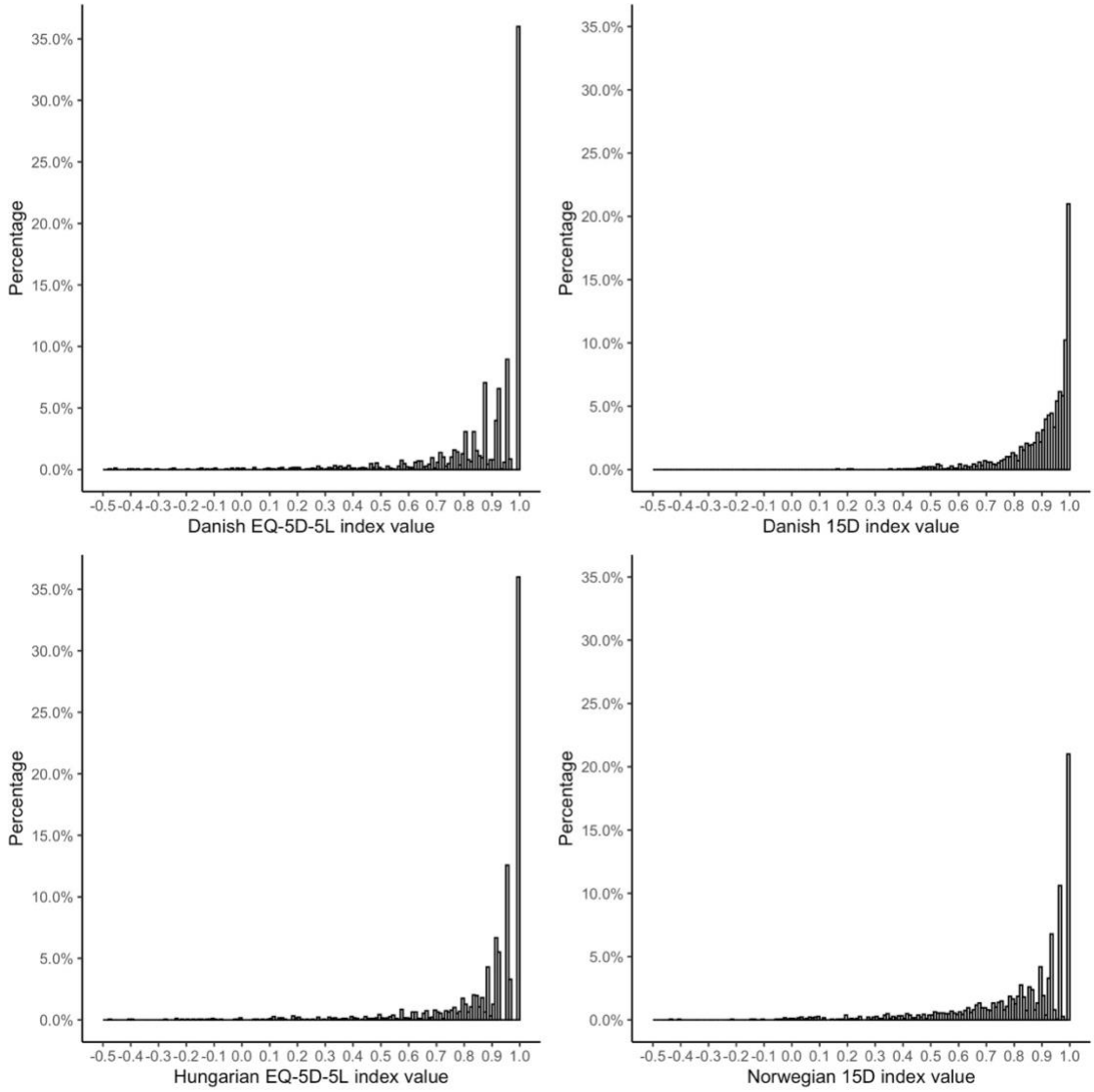

Figure 1. Distribution of EQ-5D-5L and 15D index values (140)

In the total sample, the mean index value was the highest using the Danish 15D (0.91, SD=0.11), followed by the Hungarian EQ-5D-5L (0.87, SD=0.21), the Danish EQ-5D-5L (0.86, SD=0.22), and the Norwegian 15D value set (0.81, SD=0.22). The floor was negligible for 15D and not present for the EQ-5D-5L. For the Danish EQ-5D-5L, 1.4% of the index values were in the negative range, while for the Danish 15D, the theoretical minimum is higher than 0. However, 1.2% of the Hungarian EQ-5D-5L and 0.9% of the Norwegian 15D index values were negative. When the index value range was split with a bin width of 0.05, the Norwegian 15D showed the best relative informativity (J') (0.63), followed by the Danish EQ-5D-5L (0.53), the Hungarian EQ-5D-5L (0.49), while the lowest J' was demonstrated by the Danish 15D (0.44) (Table 5).

Table 5. Characteristics of EQ-5D-5L and 15D health state profiles and index values (140)

	EQ-5D-5L				15D				
Health state profiles									
Theoretical number of health state profiles	3,125				30,517,578,125				
Observed number of health state profiles	270				1030				
Proportion of health state profiles used (%)	8.6				$3.4*10^{-6}$				
Floor (%)	0 (0.0)				1 (0.0)				
Ceiling (%)	679 (36.0)				396 (21.0)				
Shannon's index (H')	4.97				8.11				
H' max	11.61				34.83				
Shannon's evenness index (J')	0.43				0.23				
Index values	***Danish value set***		***Hungarian value set***		***Danish value set***		***Norwegian value set***		
Theoretical range	-0.758 to 1.0		-0.848 to 1.0		0.160 to 1.0		-0.516 to 1.0		
Observed range	-0.595 to 1.0		-0.587 to 1.0		0.160 to 1.0		-0.516 to 1.0		
Mean (SD) index value	0.86 (0.22)		0.87 (0.21)		0.91 (0.11)		0.81 (0.22)		
Median (IQR) index value	0.93 (0.19)		0.96 (0.16)		0.95 (0.12)		0.89 (0.25)		
Proportion of negative index values (%)	1.4		1.2		0		0.9		
Shannon's index (H') [a]	2.84		2.62		2.35		3.36		
H' max [a]	5.36		5.36		5.36		5.36		
Shannon's evenness index (J') [a]	0.53		0.49		0.44		0.63		
10 most common health state profiles	**Profile**	**Frequency**	**Relative frequency (%)**	**Index value**		**Profile**	**Frequency**	**Relative frequency (%)**	**Index value**	
				Danish value set	***Hungarian value set***				***Danish value set***	***Norwegian value set***
	11111	679	36.0	1.00	1.00	111111111111111	396	21.0	1.00	1.00
	11121	120	6.4	0.95	0.96	111121111111111	61	3.2	0.99	0.97
	11112	114	6.0	0.93	0.96	121111111111111	30	1.6	0.99	0.97
	11122	112	5.9	0.88	0.92	111111111111211	29	1.5	0.99	0.96
	21121	56	3.0	0.91	0.92	111111111111121	24	1.3	0.98	0.96
	21111	49	2.6	0.96	0.97	111121111111121	23	1.2	0.97	0.93
	21122	40	2.1	0.84	0.88	111121111111211	23	1.2	0.97	0.93
	11123	26	1.4	0.76	0.86	111121111111221	19	1.0	0.96	0.89
	21222	25	1.3	0.81	0.85	111111121111111	16	0.8	0.98	0.96
	11113	24	1.3	0.81	0.91	111221111111111	13	0.7	0.97	0.93

[a] To allow for comparisons between the two instruments, we split the index value scale with a bin width of 0.05 between -1.0 and 1.0, resulting in a total of 41 intervals.
Order of domains for the EQ-5D-5L: mobility, self-care, usual activities, pain/discomfort, anxiety/depression.

Poor agreement was found between the Danish EQ-5D-5L and 15D index values with an ICC of 0.363 (95% confidence interval: 0.342 to 0.385, p<0.001). In contrast, good agreement was observed between the Hungarian EQ-5D-5L and Norwegian 15D index values with an ICC of 0.607 (95%CI 0.516-0.677, p<0.001). The Bland-Altman plot indicated that 93.3% of the points lay within the 95% limits of agreement between the Danish EQ-5D-5L and 15D (94.2% between the Hungarian EQ-5D-5L and Norwegian 15D). Differences between the EQ-5D-5L and 15D index values increased at lower mean values for both value set pairs (Appendix 6).

Using the Danish value sets, a strong correlation was found between the EQ-5D-5L and 15D index values (0.671), and the EQ-5D-5L index value and EQ VAS value (0.604), while a moderate correlation was found between the 15D index value with the EQ VAS (0.534). EQ-5D-5L index values demonstrated a strong correlation with its dimensions, except for self-care, where the correlation was moderate (-0.482). By contrast, correlation coefficients between 15D dimensions and the EQ-5D-5L index values were ranging from -0.596 (vitality) to -0.176 (eating). 15D index value correlated moderately or strongly with most of its dimensions, while only weakly with the eating dimension (-0.346). As for the EQ-5D-5L dimensions with the 15D index value, the strongest correlation was observed for the pain/discomfort dimension (-0.629), while the weakest for self-care (-0.369). These results were confirmed by the sensitivity analysis (Table 4).

Both the Danish EQ-5D-5L and 15D index values were able to discriminate between all chronic condition groups with moderate or large effect sizes (ranging from 0.688 to 3.810 for the EQ-5D-5L and from 0.623 to 3.018 for the 15D) (Table 6). Overall, the EQ-5D-5L was able to discriminate more effectively between 38/41 (93%) known-groups (RE>1). Nevertheless, the bootstrap analysis suggested that results were significant in only five condition groups, dementia (RE=1.465), other physical health conditions (RE=1.448), bipolar depression (RE=1.385), thyroid diseases (RE=1.269), and gastroesophageal reflux disease (RE=1.251). Using the Hungarian EQ-5D-5L and the Norwegian 15D value sets, effect sizes were large in all condition groups, and RE was >1 in 36/41 (88%) known-groups. However, according to the results of the bootstrap analysis, the difference was only significant in four condition groups: dementia (RE=1.672), chronic kidney disease (RE=1.456), other physical health conditions (RE=1.454), and urinary incontinence (RE=1.302) (Appendix 7).

Table 6. Known-groups validity of the EQ-5D-5L and 15D (Danish value sets) (140)

	n (%)	EQ-5D-5L				15D				RE [b]	95% CI [c]
		Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES	Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES		
Healthy	383 (20.3)	0.94 (0.12)	1.0 (0.93-1.00)	-	-	0.95 (0.10)	0.99 (0.95-1.0)	-	-	-	-
Physical conditions											
Hypertension	527 (27.9)	0.79 (0.27)	0.88 (0.75-0.96)	<0.001	0.696	0.88 (0.11)	0.91 (0.83-0.97)	<0.001	0.650	1.071	0.884-1.365
Musculoskeletal diseases	461 (24.4)	0.73 (0.29)	0.83 (0.67-0.91)	<0.001	0.922	0.86 (0.11)	0.89 (0.80-0.95)	<0.001	0.844	1.092	0.930-1.350
Allergies	318 (16.9)	0.82 (0.24)	0.89 (0.76-1.0)	<0.001	0.697	0.89 (0.11)	0.92 (0.84-0.97)	<0.001	0.623	1.119	0.893-1.517
Cardiovascular disease	259 (13.7)	0.70 (0.31)	0.81 (0.62-0.92)	<0.001	1.134	0.83 (0.13)	0.85 (0.75-0.93)	<0.001	1.082	1.048	0.893-1.260
Gastrointestinal or hepatic disease	241 (12.8)	0.74 (0.30)	0.84 (0.65-0.93)	<0.001	0.993	0.85 (0.13)	0.88 (0.79-0.95)	<0.001	0.894	1.111	0.924-1.389
Hyperlipidaemia	240 (12.7)	0.77 (0.28)	0.86 (0.72-0.95)	<0.001	0.882	0.86 (0.12)	0.89 (0.80-0.96)	<0.001	0.836	1.056	0.869-1.334
Eye or visual diseases	231 (12.2)	0.73 (0.29)	0.83 (0.64-0.93)	<0.001	1.079	0.83 (0.13)	0.84 (0.76-0.93)	<0.001	1.111	0.971	0.813-1.170
Diabetes	205 (10.9)	0.76 (0.31)	0.86 (0.72-0.96)	<0.001	0.902	0.86 (0.13)	0.89 (0.80-0.97)	<0.001	0.784	1.152	0.930-1.502
Gastroesophageal reflux disease	186 (9.9)	0.74 (0.30)	0.84 (0.67-0.93)	<0.001	1.045	0.86 (0.12)	0.89 (0.80-0.96)	<0.001	0.834	1.251	1.012-1.619
Respiratory diseases	175 (9.3)	0.79 (0.28)	0.88 (0.71-0.95)	<0.001	0.861	0.85 (0.12)	0.88 (0.79-0.94)	<0.001	0.905	0.952	0.763-1.227
Arrhythmias	172 (9.1)	0.71 (0.28)	0.8 (0.64-0.91)	<0.001	1.284	0.82 (0.13)	0.84 (0.75-0.92)	<0.001	1.154	1.112	0.913-1.389
Thyroid diseases	171 (9.1)	0.78 (0.27)	0.88 (0.72-0.95)	<0.001	0.930	0.87 (0.12)	0.90 (0.84-0.96)	<0.001	0.732	1.269	1.007-1.689
Skin diseases	166 (8.8)	0.78 (0.30)	0.88 (0.76-0.95)	<0.001	0.869	0.86 (0.12)	0.90 (0.80-0.96)	<0.001	0.809	1.074	0.867-1.402
Headache, migraine	139 (7.4)	0.71 (0.33)	0.81 (0.64-0.93)	<0.001	1.175	0.84 (0.14)	0.88 (0.77-0.96)	<0.001	0.987	1.190	0.961-1.499
Hearing impairment	133 (7.1)	0.73 (0.31)	0.84 (0.66-0.93)	<0.001	1.153	0.84 (0.13)	0.89 (0.77-0.94)	<0.001	0.982	1.174	0.959-1.515
Benign prostate hyperplasia	88 (4.7)	0.80 (0.26)	0.88 (0.77-0.95)	<0.001	0.958	0.86 (0.11)	0.89 (0.81-0.95)	<0.001	0.871	1.099	0.774-1.532
Urinary incontinence	71 (3.8)	0.68 (0.35)	0.79 (0.57-0.92)	<0.001	1.538	0.81 (0.15)	0.85 (0.72-0.91)	<0.001	1.282	1.199	0.967-1.525
Cancer, leukaemia, lymphoma	46 (2.4)	0.73 (0.31)	0.85 (0.65-0.93)	<0.001	1.416	0.83 (0.14)	0.87 (0.75-0.94)	<0.001	1.098	1.290	0.951-1.828
Chronic kidney disease	29 (1.5)	0.71 (0.27)	0.83 (0.64-0.93)	<0.001	1.735	0.83 (0.13)	0.85 (0.77-0.92)	<0.001	1.209	1.435	0.986-2.022
Epilepsy	17 (0.9)	0.62 (0.39)	0.72 (0.54-0.93)	0.003	2.309	0.79 (0.16)	0.8 (0.70-0.92)	<0.001	1.543	1.497	0.905-2.308
Liver cirrhosis	14 (0.7)	0.63 (0.44)	0.77 (0.43-0.99)	0.019	2.259	0.78 (0.19)	0.79 (0.67-0.95)	0.005	1.645	1.373	0.968-1.849
Other physical health conditions	92 (4.9)	0.76 (0.24)	0.84 (0.64-0.95)	<0.001	1.236	0.86 (0.11)	0.89 (0.80-0.94)	<0.001	0.854	1.448	1.075-2.008

	n (%)	EQ-5D-5L				15D				RE [b]	95% CI [c]
		Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES	Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES		
Mental conditions											
Smoking addiction	381 (20.2)	0.80 (0.27)	0.88 (0.76-0.96)	<0.001	0.688	0.88 (0.12)	0.92 (0.84-0.97)	<0.001	0.628	1.096	0.896-1.442
Anxiety, phobia, or panic disorder	172 (9.1)	0.64 (0.32)	0.72 (0.51-0.88)	<0.001	1.506	0.79 (0.15)	0.82 (0.69-0.90)	<0.001	1.401	1.075	0.910-1.308
Sleeping disorders	169 (9.0)	0.65 (0.32)	0.76 (0.57-0.88)	<0.001	1.459	0.81 (0.13)	0.84 (0.72-0.91)	<0.001	1.253	1.164	0.969-1.440
Other addictions [d]	98 (5.2)	0.70 (0.34)	0.81 (0.59-0.93)	<0.001	1.342	0.82 (0.17)	0.86 (0.72-0.93)	<0.001	1.155	1.162	0.938-1.474
Depression or dysthymia	79 (4.2)	0.54 (0.35)	0.68 (0.35-0.80)	<0.001	2.228	0.75 (0.14)	0.78 (0.66-0.84)	<0.001	1.861	1.198	0.953-1.496
Alcohol addiction	73 (3.9)	0.75 (0.29)	0.86 (0.67-0.93)	<0.001	1.227	0.82 (0.16)	0.86 (0.74-0.93)	<0.001	1.167	1.052	0.765-1.415
Substance addiction	55 (2.9)	0.63 (0.36)	0.75 (0.55-0.90)	<0.001	1.870	0.77 (0.19)	0.81 (0.65-0.92)	<0.001	1.533	1.220	0.955-1.595
Sexual disorder	40 (2.1)	0.71 (0.34)	0.82 (0.60-0.93)	<0.001	1.545	0.79 (0.15)	0.82 (0.72-0.88)	<0.001	1.524	1.014	0.729-1.349
Bipolar depression	35 (1.9)	0.60 (0.32)	0.68 (0.36-0.85)	<0.001	2.398	0.76 (0.16)	0.81 (0.64-0.87)	<0.001	1.732	1.385	1.019-1.859
Personality disorder	31 (1.6)	0.53 (0.35)	0.64 (0.35-0.78)	<0.001	2.815	0.71 (0.16)	0.74 (0.63-0.82)	<0.001	2.257	1.248	0.904-1.667
Learning disability	28 (1.5)	0.71 (0.35)	0.86 (0.64-0.97)	0.002	1.590	0.80 (0.21)	0.87 (0.66-0.96)	0.001	1.377	1.155	0.678-1.707
Eating disorder	26 (1.4)	0.64 (0.39)	0.78 (0.50-0.90)	<0.001	2.060	0.78 (0.19)	0.86 (0.61-0.92)	<0.001	1.572	1.310	0.934-1.810
Obsessive compulsive disorder	21 (1.1)	0.49 (0.43)	0.72 (0.33-0.78)	<0.001	3.027	0.67 (0.17)	0.70 (0.53-0.83)	<0.001	2.614	1.158	0.711-1.712
Dementia	18 (1.0)	0.44 (0.32)	0.47 (0.32-0.63)	<0.001	3.810	0.68 (0.15)	0.66 (0.54-0.80)	<0.001	2.601	1.465	1.035-2.085
Psychotic disorders	17 (0.9)	0.61 (0.42)	0.76 (0.43-0.92)	0.005	2.314	0.67 (0.21)	0.65 (0.51-0.84)	<0.001	2.551	0.907	0.443-1.437
Post-traumatic stress disorder	14 (0.7)	0.49 (0.28)	0.51 (0.35-0.66)	<0.001	3.569	0.64 (0.18)	0.66 (0.50-0.75)	<0.001	2.955	1.208	0.787-1.751
Impulse-control disorder	14 (0.7)	0.56 (0.41)	0.64 (0.34-0.93)	0.004	2.772	0.70 (0.17)	0.65 (0.61-0.83)	<0.001	2.356	1.177	0.666-1.813
Autism spectrum disorder	11 (0.6)	0.50 (0.36)	0.52 (0.38-0.79)	0.002	3.463	0.64 (0.22)	0.67 (0.46-0.80)	0.001	2.902	1.193	0.655-1.911
Attention deficit hyperactivity disorder	10 (0.5)	0.54 (0.36)	0.66 (0.32-0.81)	0.007	3.157	0.63 (0.20)	0.62 (0.48-0.79)	0.001	3.018	1.046	0.563-1.570

CI confidence intervals, ES effect size, RE relative efficiency.

[a] Student's t-test compared to the healthy subgroup, where $p < 0.05$ was considered statistically significant.

[b] Relative efficiency compared to 15D.

[c] 2000 bootstrap samples with accelerated bias correction.

[d] Includes gambling or other addictions.

4.1.4 Subgroup analysis

The subgroup analysis for the physical and mental health condition subgroups yielded similar results to those of the total sample (Appendices 3-5). Lower ceiling was observed both in the mental (18.7%) and physical health conditions subgroups (25.5%) compared to the total sample (36.0%) for the EQ-5D-5L, while the floor was 0% in both subgroups. Similarly, for the 15D, the ceiling was reduced to a greater extent in the mental health condition subgroup (10.1%) than in the physical health condition subgroup (12.3%) against the total sample (21.0%) (Table 2). In line with previous results, J' was greater for the EQ-5D-5L than for the 15D in both subgroups (Table 3). The average size of inconsistency was similar for physical and mental health conditions (Appendices 8-9). The ICC stood at 0.311 (95% CI 0.285-0.338, p<0.001) for the physical health conditions subgroup, while reached 0.336 (95% CI 0.302-0.371, p<0.001) for the mental health subgroup. The correlation between the Danish EQ-5D-5L and Danish 15D index values was higher in both the physical and mental health condition subgroups (0.736 and 0.702) than in the total sample (0.671). As for the corresponding dimensions, correlations between dimensions were, in general, higher in both subgroups than in the total sample (Appendices 10-11). The sensitivity analyses (Appendices 12-15) with the Hungarian EQ-5D-5L and Norwegian 15D value sets mostly supported these results; however, the agreement was good in both the physical (ICC=0.653, 95% CI 0.561-0.722, p<0.001) and mental (ICC=0.632, 95% CI 0.495-0.725, p<0.001) health condition subgroups.

4.2 15D population norms study

4.2.1 Characteristics of the study population

A target sample size of 2000 respondents was achieved with a 77.8% response rate. The main characteristics of the study sample are presented in Appendix 16. The mean age was 46.3 (SD = 16.9), with 57.3% being female. The sample's composition reasonably approximated that of the Hungarian general population. However, those with secondary education were slightly underrepresented, while those with tertiary were overrepresented. The 25-34 age group was somewhat overrepresented as well. Almost two-thirds of the study sample, 1261 participants reported chronic physical conditions (63.1%) and 703 reported mental health conditions (35.2%) diagnosed by a physician, resulting in 1429 respondents with chronic illness, which accounts for 71.5% of the sample.

4.2.2 Health problems by 15D domains

The majority of the study population (78.7%) reported having problems in at least one 15D domain. Respondents experienced the least problems in eating (5.5%), then in speech (9.5%) and mental function (15.2%), while sleeping problems were the most frequently reported affecting 50.7% of the population, followed by vitality (49.2%) and distress (43.6%). Comparing the responses by gender, females had significantly more problems with distress than males (50.7% vs. 34.2%), as well as vitality (53.2% vs. 44.0%), sleeping (54.5% vs. 45.7%), depression (34.1% vs. 27.3%), and discomfort and symptoms (33.8% vs. 27.8%). On the other hand, females had significantly fewer issues with hearing (13.6% vs. 19.1%), sexual activities (27.4% vs. 32.6%), and speech (8.2% vs. 11.2%). The difference between the two genders was insignificant for mobility, vision, breathing, eating, excretion, usual activities, and mental function (Figure 2).

In general, the least problems in all age groups were found with eating, ranging from 2.0% (65-year-olds or more) to 12.9% (18-24-year-olds), while respondents reported the most problems with sleeping for the 18-24- (49.5%), 25-34- (49.4%) and 55-64-year-olds (55.5%), and vitality for the 35-44- (49.6%), 45-54- (52.3%), as well as the at least 65-year-olds (55.0%). Problems tended to increase with age in the mobility, vision, hearing, breathing, excretion, usual activities, vitality, and sexual activities domains. Problems decreased with age in the eating, speech, mental function, depression, and distress domains. The difference between the age groups was insignificant for the sleeping and discomfort and symptoms domains (Figure 3).

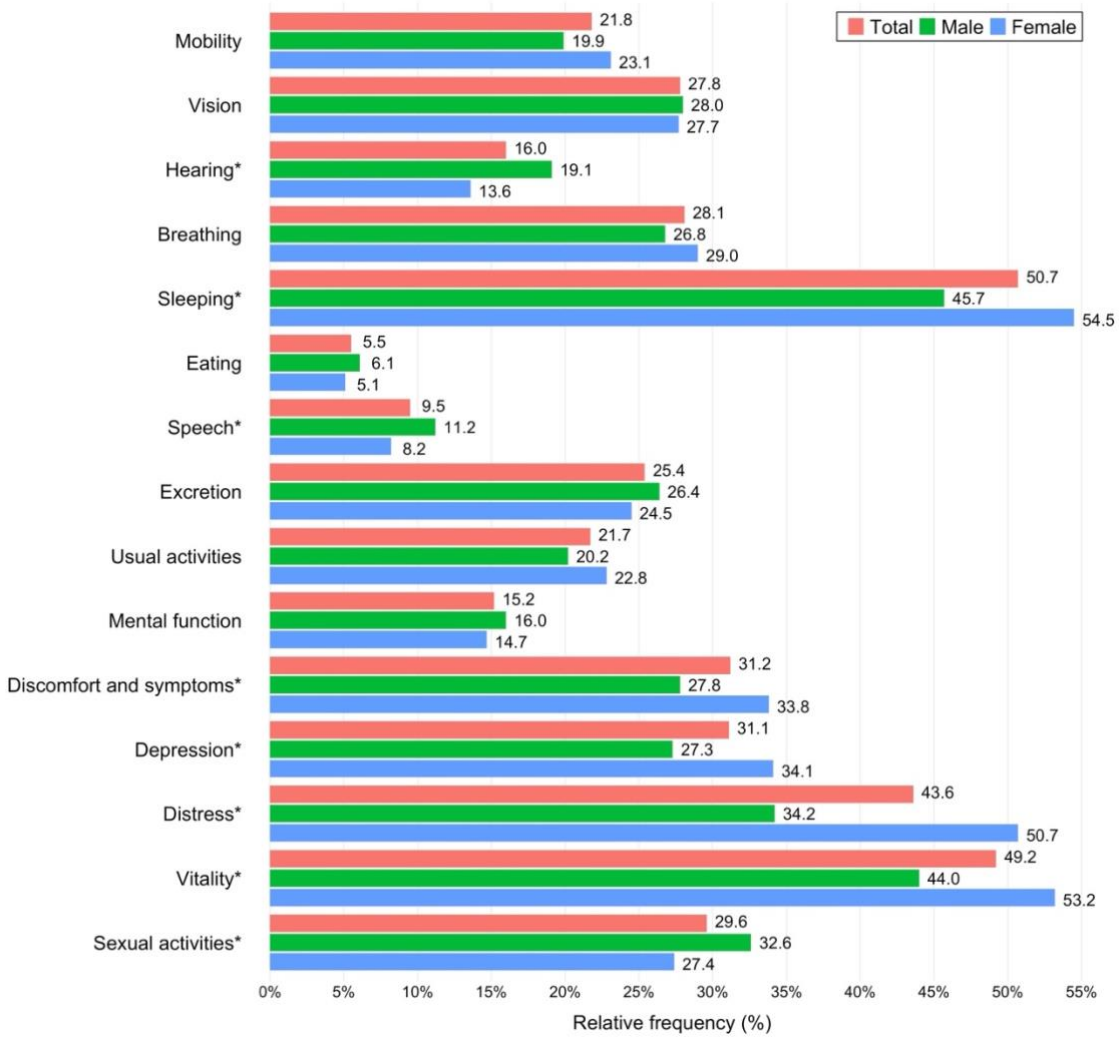

Figure 2. Proportion of respondents reporting any problems in 15D domains (141)

Pearson's χ^2 test was performed to assess the difference in the proportion of problems between genders. All domains where p-value was <0.05 are marked with asterisks.

When comparing gender and age groups, both males and females in every age group had the least problems with eating (Appendix 17). As for males, the 18-24-, 25-34-, and 55-64-year-olds had the most problems with sleeping, the 35-44- and 45-54-year-olds with vitality, and the 65-year-olds or more with sexual activities. In comparison, the 18-24 and 55-64-year-old females experienced the most problems with sleeping, while the 25-34, 35-44-, 45-54-, and 65-year-olds or more with vitality, as well as the 25-34-year-olds also with distress. Appendices 18-20 present the responses on each 15D domain in different age groups for all participants, then separately for males and females.

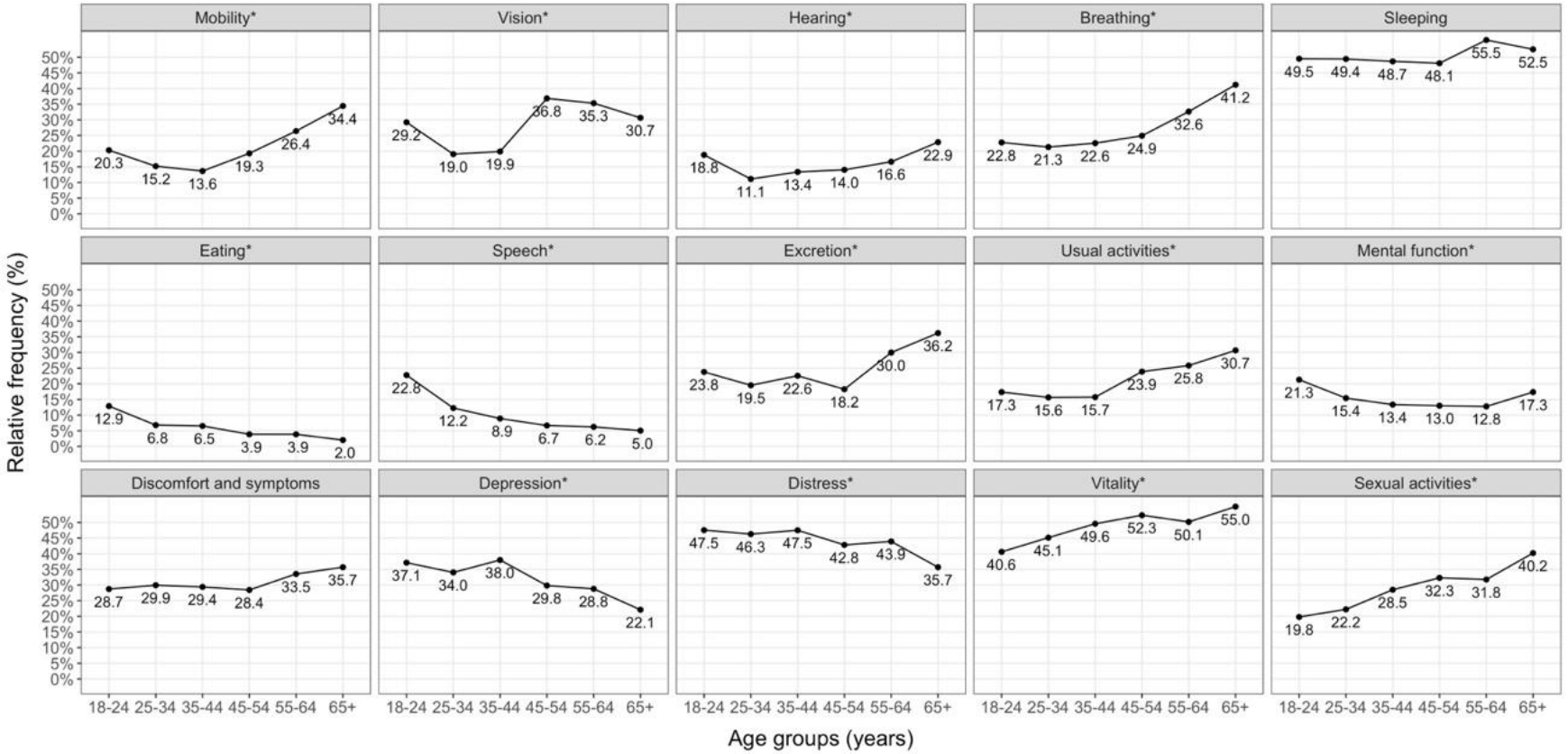

Figure 3. Proportion of respondents reporting any problems in each domain by age groups (141)

Pearson's χ^2 test was performed to assess the difference between age groups. All domains where p-value was <0.05 are marked with asterisks.

Summary data of mean LS are presented in Appendices 21-23. In the total sample, respondents had the highest mean LS in vitality (18.1), while the lowest mean LS in eating (2.3). As for genders, females had significantly higher mean LS than males in distress (19.2 vs. 12.6), sleeping (19.8 vs. 15.7), vitality (19.7 vs. 16.0), discomfort and symptoms (11.8 vs. 9.7), depression (12.7 vs. 10.7), and breathing (10.5 vs. 8.8), while lower mean LS in sexual activities (11.8 vs. 15.3) and hearing (5.1 vs. 6.6). When comparing these results with the relative frequency of problems, differences between the two genders were found to be significant for both indicators in hearing, sleeping, discomfort and symptoms, depression, distress, vitality, and sexual activities health domains. Where females had more problems, they also had a higher mean LS. There was no significant difference between the relative frequency of problems between the two genders in breathing; however, males had a higher mean LS. Likewise, males had more problems with speech than females, but the difference in their mean LS was insignificant.

4.2.3 Mean 15D index values by sociodemographic and health-related characteristics

The mean 15D index value was 0.810 (95% CI 0.800-0.819), and 0.8% of the sample was in the negative range. Differences in index values between subgroups were insignificant for gender, age groups, and geographical region (Appendix 16). Respondents with higher level of education had significantly higher mean 15D index values, as well as those living in the capital or larger cities, living in a domestic partnership or marriage, and those with higher net income per capita in their households. As for employment status, students had the highest average index values, followed by employed, then retired respondents, and homemakers/housewives, while disability pensioners had the lowest mean index value.

Table 7. Mean 15D index values by gender and age groups (141)

Age groups	Total				Males				Females			
	n	%	15D index values		n	%	15D index values		n	%	15D index values	
			Mean	95% CI			Mean	95% CI			Mean	95% CI
18-24	202	10.1	0.782	0.741-0.822	85	9.9	0.741	0.667-0.816	117	10.2	0.811	0.767-0.855
25-34	441	22.1	0.823	0.801-0.844	148	17.3	0.822	0.783-0.860	293	25.6	0.823	0.798-0.849
35-44	337	16.9	0.819	0.795-0.843	162	18.9	0.824	0.788-0.860	175	15.3	0.814	0.782-0.846
45-54	285	14.3	0.825	0.802-0.848	131	15.3	0.857	0.826-0.888	154	13.4	0.798	0.764-0.832
55-64	337	16.9	0.803	0.781-0.826	145	17.0	0.837	0.808-0.865	192	16.8	0.778	0.745-0.811
65 and above	398	19.1	0.796	0.777-0.815	184	21.5	0.812	0.786-0.837	214	18.7	0.783	0.755-0.810
Total	2000	100.0	0.810	0.800-0.819	855	100.0	0.820	0.805-0.835	1145	100.0	0.802	0.789-0.815

CI confidence intervals.

Table 8. Mean 15D index values according to chronic health conditions (141)

Variables	N	%	Mean	95% CI
Healthy	406	20.3	0.903	0.884-0.922
Physical health conditions	***1261***	***63.1***	***0.781***	***0.769-0.792***
Allergies	332	16.6	0.764	0.741-0.788
Hypertension	551	27.6	0.754	0.735-0.772
Thyroid diseases	178	8.9	0.744	0.711-0.777
Atopic dermatitis	56	2.8	0.731	0.661-0.802
Psoriasis	53	2.7	0.728	0.665-0.791
Diabetes	218	10.9	0.727	0.694-0.759
Other physical health conditions	97	4.9	0.717	0.676-0.758
Other skin diseases	44	2.2	0.715	0.644-0.785
Gastroesophageal reflux disease	194	9.7	0.715	0.682-0.747
Musculoskeletal diseases	483	24.2	0.713	0.693-0.733
Hyperlipidaemia	252	12.6	0.712	0.682-0.741
Benign prostate hyperplasia	90	4.5	0.711	0.666-0.757
Cataract	85	4.3	0.707	0.661-0.753
Asthma	119	6.0	0.701	0.659-0.742
Chronic bronchitis, emphysema, COPD	101	5.1	0.701	0.656-0.747
Acne	37	1.9	0.696	0.615-0.777
Hearing impairment	136	6.8	0.682	0.639-0.725
Cancer, leukaemia, lymphoma	50	2.5	0.676	0.603-0.749
Heart attack	37	1.9	0.676	0.587-0.765
Headache, migraine	147	7.4	0.674	0.631-0.717
Glaucoma	32	1.6	0.670	0.590-0.751
Inflammatory bowel disease	38	1.9	0.665	0.590-0.739
Coronary artery disease, angina	58	2.9	0.651	0.586-0.715
Chronic kidney disease	30	1.5	0.647	0.555-0.739
Arrhythmias	178	8.9	0.642	0.607-0.678
Urinary incontinence	74	3.7	0.625	0.560-0.689
Visual impairment	171	8.6	0.618	0.580-0.655
Other heart disease	75	3.8	0.612	0.547-0.676
Epilepsy	17	0.9	0.578	0.424-0.732
Stroke	34	1.7	0.567	0.470-0.664
Gastric or duodenal ulcer	40	2.0	0.561	0.467-0.656
Liver cirrhosis	14	0.7	0.557	0.343-0.772
Mental health conditions	***703***	***35.2***	***0.721***	***0.703-0.739***
Smoking addiction	406	20.3	0.757	0.734-0.781
Other addictions	10	0.5	0.717	0.573-0.860
Gambling addiction	58	2.9	0.684	0.601-0.767
Alcohol addiction	79	4.0	0.646	0.579-0.712
Generalized anxiety disorder	307	15.4	0.645	0.614-0.676
Sleeping disorders	178	8.9	0.620	0.582-0.658
Learning disability	30	1.5	0.607	0.462-0.752
Substance addiction	24	1.2	0.587	0.422-0.752
Sexual disorder	40	2.0	0.567	0.477-0.657
Panic disorder	115	5.8	0.564	0.514-0.615
Eating disorder	27	1.4	0.560	0.424-0.696
Prescription drug addiction	56	2.8	0.545	0.452-0.638
Bipolar depression	35	1.8	0.529	0.426-0.633
Unipolar major depression	28	1.4	0.522	0.411-0.633
Phobia	49	2.5	0.492	0.393-0.590
Dysthymia	64	3.2	0.475	0.411-0.539
Impulse-control disorder	15	0.8	0.443	0.265-0.622
Personality disorder	31	1.6	0.421	0.309-0.532
Dementia	18	0.9	0.373	0.230-0.515
Psychotic disorders	17	0.9	0.371	0.171-0.572
Obsessive compulsive disorder	21	1.1	0.360	0.216-0.505
Attention deficit hyperactivity disorder	11	0.6	0.315	0.074-0.556
Autism spectrum disorder	11	0.6	0.311	0.044-0.579
Post-traumatic stress disorder	14	0.7	0.299	0.115-0.483

CI confidence intervals, COPD chronic obstructive pulmonary disease.
Participants could report having both physical and mental health conditions.

The mean 15D index values by age and gender are summarised in Table 7. Regarding women, no trend-like relationship can be discovered with advancing age; however, in the case of men, that relationship is somewhat inverse U-shaped.

Mean index values by different physical and mental health conditions are presented in Table 8. Healthy respondents had the highest mean index value (0.903). Among the physical conditions, respondents with allergies (0.764), hypertension (0.754), and thyroid diseases (0.744) had the highest 15D index values, while those with stroke (0.567), gastric or duodenal ulcer (0.561), and liver cirrhosis (0.557) had the lowest. In contrast to physical health conditions, participants with mental health conditions had significantly lower mean 15D index values (0.781 vs. 0.721, $p<0.0001$). Among mental conditions, the higher mean values were reported in respondents smoking (0.757), having other addictions (0.717), and gambling addiction (0.684), while the lowest values were reported in attention deficit hyperactivity disorder (0.315), autism spectrum disorder (0.311) and post-traumatic stress disorder (0.299).

4.2.4 Predictors of 15D index values

Table 9 shows the results of the multivariate linear regression of 15D index values. Higher index values were associated with advancing age categories, reaching their highest in the 45-54 age group, then the value gradually decreased in the older age groups, revealing an inverse U-shaped curve. Respondents with a higher level of education had higher index values. Regarding employment status, disability pensioners' index value was significantly lower than those of being employed, while students' index value was higher. Respondents being married or in a domestic partnership also had higher index values as opposed to being single. Gender was not associated with the index value. Settlement type, geographical region, being retired, unemployed, homemaker/housewife, or other, being widowed or divorced, as well as household's per capita net monthly income were also insignificant in the model.

Table 9. Multivariate linear regression of 15D index values (141)

Variables	Coefficient	95% CI	p-value
Intercept	0.799	0.744, 0.854	<0.0001
Gender			
Male [a]	-	-	-
Female	-0.005	-0.025, 0.014	0.5834
Age groups (years)			
18-24	-	-	-
25-34	0.050	0.000, 0.100	0.0498
35-44	0.077	0.025, 0.129	0.0035
45-54	0.090	0.039, 0.142	0.0006
55-64	0.089	0.035, 0.144	0.0014
65 and above	0.075	0.014, 0.136	0.0165
Highest level of education			
Primary	-0.028	-0.052, -0.003	0.0253
Secondary	-0.018	-0.035, 0.000	0.0512
Tertiary [a]	-	-	-
Settlement type			
Capital [a]	-	-	-
City	-0.004	-0.035, 0.028	0.8213
Village	-0.024	-0.058, 0.009	0.1575
Geographical region			
Central Hungary [a]	-	-	-
Great Plain and North	0.022	-0.006, 0.050	0.1264
Transdanubia	0.020	-0.011, 0.050	0.2042
Employment status			
Employed [a]	-	-	-
Retired	0.019	-0.010, 0.048	0.1890
Disability pensioner	-0.109	-0.161, -0.057	<0.0001
Student	0.076	0.013, 0.138	0.0171
Unemployed	-0.006	-0.046, 0.034	0.7567
Homemaker/housewife	0.020	-0.021, 0.062	0.3381
Other	-0.009	-0.050, 0.032	0.6748
Marital status			
Single [a]	-	-	-
Married	0.050	0.023, 0.077	0.0003
Domestic partnership	0.064	0.036, 0.092	<0.0001
Widowed	0.017	-0.032, 0.066	0.4961
Divorced	0.037	-0.003, 0.077	0.0697
Household's per capita net monthly income (HUF)			
Lower median (≤ 112,500) [a]	-	-	-
Upper median (> 112,500)	0.003	-0.019, 0.025	0.7944
Refused to answer	0.017	-0.009, 0.043	0.2072
Physical health conditions [b]			
Hypertension	-0.021	-0.040, -0.003	0.0223
Musculoskeletal diseases	-0.051	-0.069, -0.033	<0.0001
Allergies	0.005	-0.015, 0.026	0.6226
Hyperlipidaemia	-0.031	-0.054, -0.009	0.0061
Diabetes	-0.027	-0.053, -0.001	0.0413
Gastroesophageal reflux disease	0.003	-0.023, 0.030	0.8044
Thyroid diseases	0.013	-0.011, 0.038	0.2863
Arrhythmias	-0.053	-0.083, -0.023	0.0006
Visual impairment	-0.067	-0.100, -0.034	0.0001
Headache, migraine	-0.030	-0.063, 0.002	0.0671
Hearing impairment	-0.041	-0.071, -0.010	0.0092
Asthma	-0.056	-0.092, -0.021	0.0020
Chronic bronchitis, emphysema, COPD	0.000	-0.039, 0.039	0.9876
Other physical health conditions	-0.036	-0.079, 0.007	0.1014
Benign prostate hyperplasia	-0.020	-0.057, 0.017	0.2935
Cataract	-0.015	-0.057, 0.027	0.4788
Other heart disease	-0.042	-0.092, 0.008	0.0997
Urinary incontinence	-0.045	-0.091, 0.001	0.0578
Coronary artery disease, angina	-0.029	-0.090, 0.032	0.3490
Atopic dermatitis	0.023	-0.024, 0.070	0.3348
Psoriasis	-0.021	-0.068, 0.026	0.3769
Cancer, leukaemia, lymphoma	-0.021	-0.076, 0.034	0.4567
Other skin diseases	0.008	-0.054, 0.069	0.8012
Gastric or duodenal ulcer	-0.041	-0.107, 0.025	0.2201

Variables	Coefficient	95% CI	p-value
Inflammatory bowel disease	0.008	-0.051, 0.068	0.7807
Acne	0.011	-0.055, 0.077	0.7369
Heart attack	0.019	-0.057, 0.094	0.6245
Stroke	-0.054	-0.139, 0.030	0.2050
Glaucoma	-0.013	-0.096, 0.069	0.7514
Chronic kidney disease	0.053	-0.019, 0.124	0.1474
Mental health conditions [b]			
Smoking addiction	-0.011	-0.030, 0.009	0.2735
Generalized anxiety disorder	-0.107	-0.137, -0.078	<0.0001
Sleeping disorders	-0.036	-0.072, 0.000	0.0524
Panic disorder	-0.057	-0.102, -0.012	0.0125
Alcohol addiction	-0.058	-0.111, -0.005	0.0309
Dysthymia	-0.050	-0.114, 0.015	0.1316
Gambling addiction	-0.050	-0.116, 0.016	0.1373
Prescription drug addiction	-0.108	-0.185, -0.031	0.0059
Phobia	-0.095	-0.177, -0.012	0.0240
Sexual disorder	-0.086	-0.157, -0.015	0.0175
Bipolar depression	-0.006	-0.094, 0.081	0.8886
Personality disorder	-0.121	-0.231, -0.012	0.0296
Learning disability	-0.005	-0.104, 0.093	0.9198

CI confidence intervals, COPD chronic obstructive pulmonary disease.
[a] Reference category. The normative category, or the category at one of the ends was chosen as reference category.
[b] No reported condition was considered as reference category.

Eight of the 30 physical health conditions (hypertension, musculoskeletal diseases, hyperlipidaemia, diabetes, arrhythmias, visual impairment, hearing impairment, and asthma) were significantly associated with the 15D index values (Table 9). Among these conditions, the largest index value decrement was associated with visual impairment (beta=-0.067) and the smallest with hypertension (beta=-0.021). Considering the mental health conditions, seven of the 13 (generalized anxiety disorder, panic disorder, alcohol addiction, prescription drug addiction, phobia, sexual disorder, and personality disorder) were associated with the 15D index value, where personality disorder had the largest (beta=-0.121) and panic disorder the smallest (beta=-0.057) impact. In line with previous results, mental health conditions were associated with larger decrement in the index value, on average, than physical health conditions.

4.3 EQ-5D-5L, PROPr and SF-6D population norms study

4.3.1 Characteristics of the study population

The sociodemographic and health-related characteristics of the study sample are presented in Table 10 and Appendix 24. The composition of the sample (n=1631) closely approximated that of the Hungarian population regarding age, gender, education, employment, marital status, place of residence and geographical region. Nonetheless, there were small deviations; participants with secondary education or those aged 75 years or over were somewhat underrepresented, while those with a college/university degree

were slightly overrepresented. More than two-thirds of the sample (67.4%) self-reported having a physician-diagnosed chronic health condition.

4.3.2 Health problems by domains

The distribution of the responses on the domains of each measure is presented in Appendices 25-33, first for the total sample, then separately for males and females.

Generally, the most commonly reported problem on the EQ-5D-5L was pain/discomfort (43.8%), while sleep disturbance on the PROPr (93.8%) and vitality on the SF-6D (87.1%) (Figure 4). In contrast, respondents experienced the fewest problems in EQ-5D-5L self-care (7.5%), PROPr physical functioning (39.1%) and SF-6D role limitations (37.8%).

With advancing age groups, problems tended to increase significantly in physical function, self-care, usual activities/role limitations and pain/discomfort for all measures (Figure 5). For mental health domains in all measures, problems significantly decreased with age. No clear trend could be detected for SF-6D vitality, but at the same time, the difference between the age groups was statistically significant. Problems tended to decrease significantly for PROPr fatigue, then suddenly rose in the oldest age group. PROPr cognitive function showed a significant U-shaped curve. No significant difference was observed for the PROPr sleep disturbance domain. For the social functioning/roles domains, after the 35-44 age group, problems significantly increased for the PROPr, while problems tended to decrease with age for the SF-6D.

Mean LS data are presented in Appendices 34 and 35. When considering the corresponding domains, the trends were almost identical to those observed when comparing the proportion of problems across domains. Participants had significantly higher mean LS on SF-6D domains, followed by PROPr and EQ-5D-5L. Physical function was an exception, where SF-6D had the highest and PROPr the lowest mean LS. As for genders, in those domains, where females reported more problems, they also had a significantly higher mean LS.

Table 10. Mean EQ-5D-5L, SF-6D and PROPr index values and EQ VAS scores by age and gender groups (135)

	Age group	Reference population (%) [a]	N	%	EQ VAS		EQ-5D-5L (Hun)		PROPr (US)		SF-6D (UK)	
					Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Total sample	***Total***	***100***	***1631***	***100***	***77.81***	***76.87-78.75***	***0.900***	***0.891-0.908***	***0.535***	***0.523-0.547***	***0.755***	***0.748-0.762***
	18-24	10.0	141	8.6	81.23 [c]	78.01-84.44	0.936 [c]	0.920-0.951	0.504	0.466-0.543	0.765	0.744-0.786
	25-34	15.2	284	17.4	80.18 [c]	78.07-82.29	0.919 [c]	0.902-0.935	0.511	0.483-0.540	0.744	0.728-0.760
	35-44	19.5	295	18.1	80.52 [c]	78.53-82.51	0.925 [c]	0.910-0.940	0.533	0.504-0.561	0.761	0.745-0.777
	45-54	16.0	281	17.2	77.23 [c]	74.84-79.62	0.899 [c]	0.877-0.920	0.551	0.521-0.581	0.770	0.754-0.787
	55-64	16.8	287	17.6	75.82 [c]	73.52-78.11	0.873 [c]	0.848-0.899	0.550	0.520-0.580	0.749	0.731-0.767
	65-74	13.0	288	17.7	74.72 [c]	72.31-77.14	0.873 [c]	0.850-0.897	0.553	0.524-0.581	0.752	0.736-0.769
	75+	9.5	55	3.4	71.87 [c]	67.07-76.68	0.854 [c]	0.806-0.902	0.496	0.434-0.558	0.727	0.694-0.761
Males	***Total***	***46.9***	***720***	***44.1***	***77.51***	***76.09-78.93***	***0.910*** [b]	***0.898-0.923***	***0.581*** [b]	***0.564-0.599***	***0.779*** [b]	***0.769-0.789***
	18-24		29	1.8	86.83 [c]	80.22-93.43	0.959 [b, c]	0.937-0.981	0.530	0.434-0.627	0.788	0.741-0.835
	25-34		88	5.4	82.25 [c]	78.70-85.80	0.925 [c]	0.892-0.957	0.580 [b]	0.531-0.630	0.778 [b]	0.750-0.805
	35-44		135	8.3	78.84 [c]	75.62-82.07	0.943 [b, c]	0.927-0.959	0.559	0.519-0.599	0.786 [b]	0.764-0.807
	45-54		139	8.5	78.03 [c]	74.76-81.30	0.925 [b, c]	0.898-0.951	0.611 [b]	0.572-0.650	0.798 [b]	0.776-0.819
	55-64		137	8.4	75.08 [c]	71.78-78.38	0.877 [c]	0.841-0.913	0.582 [b]	0.539-0.625	0.772 [b]	0.747-0.797
	65-74		150	9.2	74.87 [c]	71.53-78.20	0.892 [c]	0.860-0.924	0.602 [b]	0.563-0.640	0.772 [b]	0.749-0.795
	75+		42	2.6	72.55 [c]	66.57-78.53	0.864 [c]	0.805-0.924	0.522 [b]	0.445-0.599	0.745	0.707-0.783
Females	***Total***	***53.1***	***911***	***55.9***	***78.05***	***76.79-79.31***	***0.891*** [b]	***0.880-0.903***	***0.498*** [b]	***0.482-0.515***	***0.736*** [b]	***0.727-0.745***
	18-24		112	6.9	79.78 [c]	76.11-83.45	0.930 [b, c]	0.911-0.948	0.498	0.455-0.540	0.759	0.735-0.782
	25-34		196	12.0	79.25 [c]	76.63-81.86	0.916 [c]	0.897-0.935	0.481 [b]	0.447-0.514	0.729 [b]	0.709-0.749
	35-44		160	9.8	81.93 [c]	79.45-84.41	0.909 [b, c]	0.886-0.933	0.510	0.470-0.550	0.741 [b]	0.718-0.763
	45-54		142	8.7	76.44 [c]	72.93-79.96	0.873 [b, c]	0.840-0.907	0.493 [b]	0.450-0.537	0.744 [b]	0.719-0.768
	55-64		150	9.2	76.49 [c]	73.27-79.70	0.870 [c]	0.834-0.906	0.521 [b]	0.479-0.563	0.727 [b]	0.702-0.753
	65-74		138	8.5	74.57 [c]	71.02-78.11	0.853 [c]	0.818-0.888	0.500 [b]	0.459-0.541	0.730 [b]	0.706-0.754
	75+		13	0.8	69.69 [c]	62.12-77.27	0.819 [c]	0.739-0.899	0.410 [b]	0.335-0.485	0.670	0.602-0.739

EQ VAS = EuroQol Visual Analogue Scale; PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions

a – Hungarian Central Statistical Office: Microcensus 2016.

b – Student's t-test p-value<0.05 between males and females.

c – Analysis of variance p-value<0.05 between age groups.

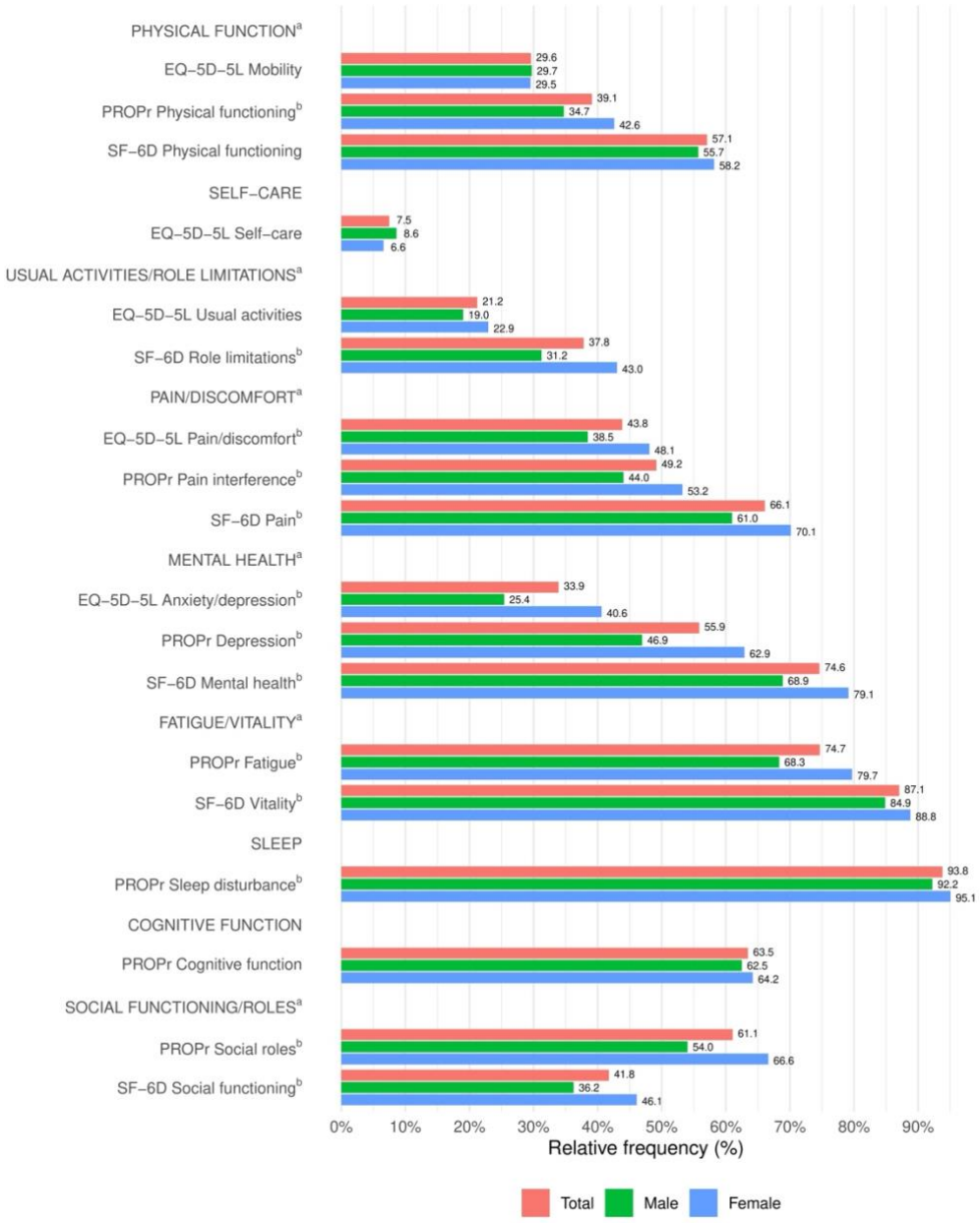

Figure 4. Proportion of respondents reporting problems in health domains of three preference-accompanied measures by gender (135)

Pearson's χ^2 test was performed where a health domain was covered by more than one instrument. All corresponding domain groups where there was a significant difference between the relative frequency of the domain responses (p-value<0.05) are marked with [a].
Pearson's χ^2 test was performed to assess the difference between genders in each health domain of all three instruments. All domains where there was a significant difference between the female and male subsample (p-value<0.05) are marked with [b].
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions

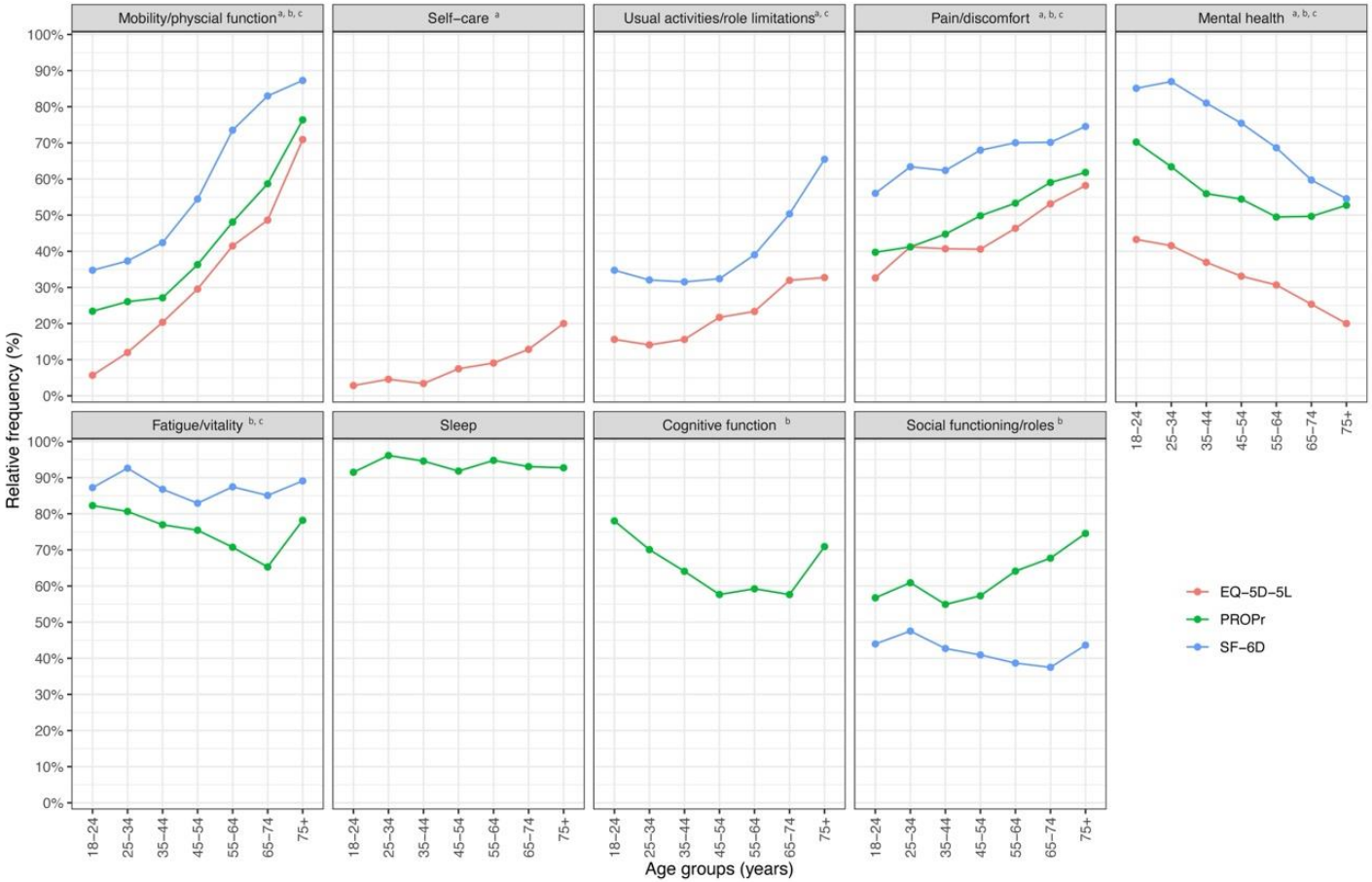

Figure 5. Proportion of respondents reporting problems in health domains of three preference-accompanied measures by age group (135)

Pearson's χ^2 test was performed to assess the difference between age groups. All domains where p-values were <0.05 are marked with [a] for EQ-5D-5L, [b] for PROPr and [c] for SF-6D.
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions

4.3.3 Respondents reporting the best possible health

A total of 40.2% of the respondents had the best possible health on the EQ-5D-5L, 2.3% on the PROPr and 5.5% on the SF-6D. In the total sample, the proportion of respondents reporting the best possible health state slightly increased with the EQ-5D-5L between 18 and 44 years and started to decline steeply from the 45-54 age group (45.2%), having the lowest value in the 75+ age group (20.0%) (Appendix 36). In the case of SF-6D and EQ VAS, the proportion of respondents indicating the best possible health declined as age progressed, starting from 13.5% and 8.5% in the 18-24-year-old age group and decreasing to 1.8% and 3.9%, respectively. No substantial difference could be found between age groups in the proportion of respondents with the best possible health on PROPr, with 1.4% of the 18-24-year-olds and 3.6% of the 75+ age group having the best possible health. Similar trends were observed when the results were stratified according to gender.

4.3.4 Mean EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values by sociodemographic and health-related characteristics

The mean EQ VAS score was 77.81 (95% CI 76.87-78.75) in the total sample, and the mean index value was 0.900 (95% CI 0.891-0.908) with the EQ-5D-5L, 0.535 (95% CI 0.523-0.547) with the PROPr and 0.755 (95% CI 0.748-0.762) with the SF-6D (Table 10). Males had significantly higher index values with EQ-5D-5L, PROPr and SF-6D, while the difference between genders was insignificant with EQ VAS. In contrast, the difference between age groups was significant with EQ VAS and EQ-5D-5L, with older respondents having lower index values, whereas no difference could be detected with PROPr and SF-6D. Values in age groups ranged between 71.87 (75+) and 81.23 (18-24) for the EQ VAS, 0.854 (75+) and 0.936 (18-24) for the EQ-5D-5L, 0.496 (75+) and 0.533 (35-44) for the PROPr and 0.727 (75+) and 0.765 (18-24) for the SF-6D. On average, females had lower mean index values in all age groups using all measures. The difference between genders was statistically significant for none of the age groups on EQ VAS, the 18-24-, 35-44- and 45-54-year-old age groups on EQ-5D-5L, for all but two age groups on PROPr (18-24- and 35-44-year-olds) and on SF-6D (18-24-year-old and 75+).

A higher level of education (all instruments), higher per capita net monthly income in their households (all), married, widowed participants or those in a domestic partnership (PROPr) and students, employed respondents (all), homemakers/housewives (EQ VAS,

EQ-5D-5L, SF-6D) and retired participants (PROPr), a better self-perceived health status (all) and those never smoked (EQ-5D-5L, SF-6D) were associated with better health (Appendix 24). Participants with a history of chronic illness, doing less than 150 minutes of physical activity weekly, taking more medications regularly, and those being underweight, overweight or obese had significantly lower index values on all instruments, as well as those living in villages (EQ-5D-5L, PROPr, SF-6D) or in Eastern Hungary (PROPr), and informal caregivers (PROPr, SF-6D). Although the difference between subgroups was significant in the case of alcohol consumption for all measures, no clear trend of the mean index values could be detected.

The mean index values for different chronic health conditions can be found in Table 11. Healthy respondents had the highest mean index value for all instruments. PROPr yielded the lowest mean index values in all health conditions groups, while EQ-5D-5L yielded the highest in 28 out of 30 groups, except for liver cirrhosis and stroke, where mean SF-6D index values were higher than mean EQ-5D-5L index values. Participants with thyroid disease exhibited the highest mean EQ-5D-5L index values (0.896) and EQ VAS scores (75.40), while those with hypertension had the highest mean PROPr (0.485) and SF-6D index values (0.718). The lowest mean EQ-5D-5L and PROPr index values were observed in those with liver cirrhosis (0.498 and 0.220, respectively), and the lowest mean EQ VAS score and SF-6D index value were noted in those having other mental health conditions (53.92 and 0.578, respectively).

Table 11. Mean EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values according to chronic health conditions (135)

Variables	N	%	EQ VAS		EQ-5D-5L (Hun)		PROPr (US)		SF-6D (UK)	
			Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Healthy	396	24.3	86.66	85.29-88.03	0.966	0.956-0.977	0.652	0.629-0.675	0.834	0.822-0.846
Physical health conditions										
Thyroid disease	35	2.1	75.40	68.22-82.58	0.896	0.848-0.945	0.477	0.400-0.555	0.716	0.673-0.759
Dysmenorrhea, endometriosis	52	3.2	75.39	68.63-82.14	0.861	0.800-0.921	0.413	0.343-0.483	0.699	0.656-0.742
Allergies	284	17.4	73.89	71.60-76.19	0.874	0.853-0.896	0.470	0.441-0.498	0.714	0.698-0.730
Skin diseases	121	7.4	74.37	70.74-78.01	0.846	0.806-0.885	0.465	0.421-0.508	0.715	0.688-0.742
Hypertension	477	29.2	71.02	69.09-72.95	0.834	0.813-0.856	0.485	0.463-0.508	0.718	0.705-0.731
Glaucoma	23	1.4	70.61	62.85-78.36	0.821	0.753-0.890	0.389	0.294-0.483	0.642	0.591-0.694
Asthma	103	6.3	69.81	65.81-73.80	0.822	0.773-0.871	0.398	0.355-0.441	0.677	0.649-0.705
Musculoskeletal diseases	491	30.1	68.55	66.63-70.48	0.810	0.790-0.830	0.419	0.398-0.439	0.677	0.665-0.689
Hearing problems	96	5.9	68.54	63.94-73.14	0.772	0.707-0.837	0.434	0.378-0.490	0.677	0.646-0.709
Other visual disorders	221	13.6	68.47	65.43-71.50	0.807	0.773-0.841	0.404	0.371-0.438	0.672	0.652-0.692
Diabetes	175	10.7	68.09	64.82-71.35	0.817	0.778-0.856	0.477	0.440-0.515	0.702	0.680-0.724
Gastroesophageal reflux disease	165	10.1	67.97	64.76-71.18	0.814	0.781-0.848	0.394	0.358-0.430	0.675	0.653-0.697
Migraine	88	5.4	67.67	62.59-72.75	0.783	0.725-0.840	0.348	0.299-0.398	0.624	0.594-0.654
Hyperlipidaemia	232	14.2	67.50	64.64-70.36	0.806	0.775-0.837	0.419	0.390-0.449	0.675	0.657-0.692
Liver cirrhosis	8	0.5	67.50	46.81-88.19	0.498	0.070-0.926	0.220	0.057-0.384	0.585	0.432-0.737
Chronic kidney disease	26	1.6	67.39	57.10-77.67	0.743	0.617-0.869	0.417	0.336-0.498	0.668	0.614-0.722
Cataract	78	4.8	66.40	61.58-71.22	0.820	0.769-0.871	0.455	0.401-0.508	0.698	0.669-0.728
Gastric or peptic ulcer	35	2.1	66.23	58.57-73.89	0.819	0.760-0.878	0.368	0.283-0.454	0.666	0.617-0.714
Bronchitis, emphysema, COPD	72	4.4	65.46	60.13-70.79	0.782	0.717-0.848	0.371	0.319-0.422	0.663	0.629-0.697
Arrhythmias	144	8.8	64.42	60.44-68.41	0.775	0.729-0.821	0.387	0.345-0.429	0.656	0.632-0.681
Cancer, leukaemia, lymphoma	35	2.1	63.43	56.37-70.49	0.854	0.801-0.906	0.437	0.364-0.511	0.682	0.643-0.722
Headache	97	5.9	61.46	56.64-66.29	0.720	0.661-0.779	0.295	0.254-0.337	0.606	0.579-0.633
Urinary incontinence	64	3.9	61.33	55.04-67.62	0.680	0.591-0.768	0.354	0.288-0.419	0.639	0.596-0.681
Other cardiovascular disease	63	3.9	60.06	54.08-66.05	0.726	0.647-0.805	0.362	0.300-0.425	0.635	0.598-0.671
Heart attack	35	2.1	59.43	52.02-66.84	0.725	0.603-0.847	0.394	0.310-0.477	0.663	0.607-0.719
Coronary heart disease (angina)	49	3.0	56.86	50.47-63.25	0.694	0.597-0.791	0.362	0.296-0.428	0.641	0.600-0.682
Stroke	23	1.4	54.13	44.37-63.90	0.570	0.392-0.747	0.339	0.230-0.448	0.595	0.525-0.665
Mental health conditions										
Anxiety	167	10.2	61.60	58.20-65.00	0.707	0.663-0.751	0.281	0.251-0.311	0.607	0.587-0.627
Depression	127	7.8	59.50	55.61-63.40	0.666	0.612-0.721	0.247	0.214-0.28	0.590	0.567-0.614
Other mental health conditions	59	3.6	53.92	47.88-59.95	0.611	0.521-0.702	0.221	0.173-0.269	0.578	0.540-0.617

Both physical and mental health conditions are listed in a descending order according to EQ VAS values.
COPD = Chronic obstructive pulmonary disease
EQ VAS = EuroQol Visual Analogue Scale; PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions

4.3.5 Predictors of EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values

Table 12 shows the results of the multivariate linear regression of EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values. Females had significantly higher EQ VAS scores, whereas lower PROPr and SF-6D index values than males, all else equal. The 25-34-year-olds had lower index values with the EQ-5D-5L and with the SF-6D than the 18-24-year-old age group; however, the 45-54, 55-64 and 65-74 age groups had significantly higher index values than the youngest generation with PROPr. Respondents with a lower level of education (EQ-5D-5L, PROPr), being unemployed (EQ-5D-5L, EQ VAS) or disability pensioner (EQ-5D-5L), practising less than 150 minutes of weekly physical activities (all measures), taking five or more types of medication regularly (all measures), daily alcohol intake (PROPr), as well as being underweight or obese (SF-6D) was associated with significantly lower values. Married respondents or those in a domestic partnership had higher index values than those being single (PROPr).

Ten out of 26 chronic health conditions were associated with significantly lower SF-6D index values (Table 12). The corresponding figures for EQ VAS score, PROPr and EQ-5D-5L index values were 9, 9, and 4, respectively. Musculoskeletal diseases and other mental health conditions were the only two chronic health conditions significantly associated with lower values on all measures. Hyperlipidaemia, cancer (including leukaemia and lymphoma), headache, anxiety, and depression were associated with lower values on three out of four measures. Other mental health conditions had the largest impact on the EQ VAS scores and EQ-5D-5L index values (beta=-9.657 and -0.104), cancer (incl. leukaemia and lymphoma) on the PROPr index values (beta=-0.105) and musculoskeletal diseases on the SF-6D index values (beta=-0.065). These sociodemographic and health-related variables explained 28.50% of the variance of the EQ VAS, 39.46% of the EQ-5D-5L, 34.05% of the PROPr and 35.78% of the SF-6D values.

Table 12. Multivariate linear regression of EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values (135)

	EQ VAS β (SE)	**EQ-5D-5L** β (SE)	**PROPr** β (SE)	**SF-6D** β (SE)
Intercept	68.823 (4.214) ***	0.929 (0.029) ***	0.471 (0.050) ***	0.756 (0.029) ***
Gender				
Male [a]	-	-	-	-
Female	2.174 (0.995) *	-0.004 (0.008)	-0.044 (0.013) ***	-0.022 (0.007) **
Age (years)				
18-24 [a]	-	-	-	-
25-34	-0.602 (2.368)	-0.031 (0.013) *	-0.018 (0.028)	-0.036 (0.015) *
35-44	2.730 (2.433)	0.000 (0.014)	0.033 (0.030)	-0.004 (0.015)
45-54	0.756 (2.588)	-0.005 (0.016)	0.074 (0.031) *	0.016 (0.016)
55-64	2.570 (2.632)	0.002 (0.017)	0.106 (0.032) ***	0.024 (0.017)
65-74	3.193 (3.552)	0.021 (0.031)	0.104 (0.038) **	0.031 (0.021)
75+	1.492 (3.920)	0.000 (0.038)	0.027 (0.048)	-0.007 (0.027)
Highest level of education				
Primary school or less	0.002 (1.235)	-0.029 (0.011) **	-0.038 (0.016) *	-0.005 (0.009)
Secondary school	-1.057 (0.995)	-0.013 (0.007)	-0.028 (0.012) *	-0.008 (0.007)
College/university degree [a]	-	-	-	-
Place of residence				
Capital [a]	-	-	-	-
Other town	1.485 (1.612)	0.010 (0.012)	0.016 (0.019)	0.002 (0.011)
Village	1.106 (1.710)	0.008 (0.013)	0.006 (0.019)	-0.005 (0.011)
Geographical region				
Central Hungary [a]	-	-	-	-
Eastern Hungary	1.103 (1.430)	0.005 (0.010)	-0.025 (0.017)	0.003 (0.010)
Western Hungary	-0.215 (1.467)	-0.01 (0.011)	-0.006 (0.017)	-0.002 (0.010)
Employment status				
Employed [a]	-	-	-	-
Retired	-1.468 (1.882)	-0.036 (0.020)	0.009 (0.022)	-0.009 (0.013)
Disability pensioner	-3.412 (3.156)	-0.128 (0.039) ***	-0.049 (0.029)	-0.031 (0.020)
Student	2.318 (2.843)	-0.020 (0.015)	0.001 (0.035)	-0.022 (0.019)
Unemployed	-4.916 (2.234) *	-0.045 (0.017) **	-0.009 (0.025)	-0.023 (0.012)
Homemaker/housewife	2.086 (1.688)	0.010 (0.012)	-0.013 (0.024)	-0.004 (0.014)
Other	0.503 (1.802)	-0.013 (0.014)	0.003 (0.027)	-0.003 (0.014)
Marital status				
Single [a]	-	-	-	-
Married	2.324 (1.282)	0.016 (0.011)	0.036 (0.016) *	0.011 (0.009)
Domestic partnership	2.222 (1.441)	0.008 (0.011)	0.038 (0.017) *	0.005 (0.009)
Widowed	3.183 (2.242)	0.026 (0.021)	0.050 (0.027)	0.021 (0.015)
Divorced	1.805 (2.020)	0.014 (0.016)	0.007 (0.023)	0.015 (0.013)
Other	2.237 (2.806)	0.025 (0.019)	-0.044 (0.040)	0.007 (0.019)
Weekly physical work/sport/exercise				
Less than 150 minutes [a]	-	-	-	-
At least 150 minutes	4.471 (0.984) ***	0.035 (0.009) ***	0.048 (0.011) ***	0.023 (0.006) ***
Do not know / refused to answer	-2.519 (8.814)	0.060 (0.024) *	-0.039 (0.078)	-0.021 (0.039)
Smoking				
Currently smoking [a]	-	-	-	-
Quit smoking less than a year ago	-4.030 (3.058)	-0.052 (0.036)	-0.023 (0.032)	-0.039 (0.018) *
Quit smoking more than a year ago	-0.479 (1.264)	-0.011 (0.011)	-0.016 (0.016)	-0.002 (0.009)
Never smoked	-0.340 (1.114)	-0.001 (0.009)	-0.005 (0.013)	-0.001 (0.008)
Do not know / refused to answer	-8.134 (3.430) *	-0.044 (0.031)	-0.029 (0.041)	-0.027 (0.024)
Taking medication(s) regularly				
Do not take medication regularly [a]	-	-	-	-
1-4 types	-1.003 (0.951)	0.001 (0.007)	-0.009 (0.012)	-0.015 (0.007) *
5 or more types (i.e., polypharmacy)	-4.377 (1.871) *	-0.080 (0.021) ***	-0.055 (0.020) **	-0.040 (0.012) ***
Do not know / refused to answer	-0.198 (2.143)	0.014 (0.014)	0.007 (0.027)	0.001 (0.014)
Alcohol consumption				
Every day or almost every day [a]	-	-	-	-
5-6 day a week	0.958 (3.446)	-0.012 (0.032)	-0.021 (0.038)	-0.019 (0.021)
3-4 days a week	0.047 (2.500)	-0.012 (0.021)	0.019 (0.030)	-0.019 (0.016)
1-2 days a week	5.500 (2.073) **	0.010 (0.018)	0.1 (0.026) ***	0.016 (0.015)
2-3 days a month	2.089 (2.255)	-0.006 (0.020)	0.064 (0.027) *	0.011 (0.016)
Once a month	3.509 (2.438)	0.007 (0.019)	0.068 (0.030) *	0.011 (0.016)
Less often than once a month	3.833 (2.096)	0.023 (0.018)	0.099 (0.025) ***	0.023 (0.014)
Not once in the last 12 months	-0.239 (2.616)	-0.011 (0.023)	0.036 (0.029)	-0.017 (0.017)
Never	3.641 (2.270)	0.008 (0.019)	0.075 (0.027) **	0.033 (0.015) *
Do not know / refused to answer	8.166 (4.648)	0.057 (0.028) *	-0.057 (0.061)	-0.002 (0.028)

	EQ VAS β (SE)	EQ-5D-5L β (SE)	PROPr β (SE)	SF-6D β (SE)
Body mass index				
Underweight (below 18.5)	-4.761 (2.433)	-0.016 (0.015)	-0.027 (0.027)	-0.037 (0.016) *
Normal (between 18.5 and 24.9) [a]	-	-	-	-
Overweight (between 25 and 29.9)	-0.440 (1.102)	0.008 (0.009)	0.000 (0.014)	0.004 (0.008)
Obese (30 or over)	-0.616 (1.226)	-0.003 (0.010)	-0.017 (0.015)	-0.017 (0.009) *
Do not know / refused to answer	-2.945 (1.580)	-0.016 (0.013)	-0.041 (0.019) *	-0.017 (0.010)
Informal caregiver				
Yes	1.101 (1.092)	-0.010 (0.009)	-0.013 (0.013)	-0.014 (0.007)
No [a]	-	-	-	-
Household's per capita net monthly income (HUF)				
1st quintile (≤123,744.4) [a]	-	-	-	-
2nd quintile (>123,744.4 & ≤175,001)	-0.317 (1.762)	0.006 (0.016)	-0.004 (0.021)	-0.001 (0.012)
3rd quintile (>175,001 & ≤229,810.4)	0.903 (1.780)	0.000 (0.015)	0.029 (0.022)	0.009 (0.012)
4th quintile (>229,810.4 & ≤300,521.1)	1.643 (1.813)	-0.004 (0.017)	0.011 (0.023)	0.011 (0.013)
5th quintile (>300,521.1)	2.981 (1.694)	0.008 (0.015)	0.027 (0.021)	0.024 (0.012) *
Do not know / refused to answer	3.009 (1.674)	0.025 (0.014)	0.054 (0.021) **	0.037 (0.011) **
Chronic health conditions [b]				
Thyroid disease	-1.373 (2.684)	0.016 (0.020)	-0.026 (0.033)	-0.017 (0.017)
Dysmenorrhea, endometriosis	2.548 (3.508)	0.037 (0.023)	0.033 (0.030)	0.039 (0.016) *
Allergies	-1.789 (1.198)	0.003 (0.010)	-0.025 (0.014)	-0.015 (0.008)
Skin diseases	1.787 (1.607)	-0.003 (0.015)	-0.003 (0.018)	0.005 (0.012)
Hypertension	-1.262 (1.193)	-0.011 (0.010)	-0.007 (0.013)	0.002 (0.008)
Asthma	1.473 (1.996)	0.007 (0.017)	-0.013 (0.022)	-0.005 (0.014)
Musculoskeletal diseases	-6.363 (1.115) ***	-0.051 (0.009) ***	-0.099 (0.012) ***	-0.065 (0.007) ***
Hearing problems	1.417 (1.914)	-0.023 (0.023)	0.008 (0.024)	-0.007 (0.013)
Other visual disorders	-2.275 (1.413)	-0.008 (0.013)	-0.043 (0.016) **	-0.027 (0.009) **
Diabetes	-3.137 (1.599) *	-0.016 (0.016)	-0.012 (0.018)	-0.019 (0.011)
Gastroesophageal reflux disease	-0.715 (1.607)	0.014 (0.014)	-0.021 (0.017)	-0.001 (0.01)
Migraine	-0.052 (2.254)	-0.008 (0.024)	-0.015 (0.024)	-0.037 (0.014) **
Hyperlipidaemia	-3.465 (1.549) *	-0.020 (0.014)	-0.061 (0.015) ***	-0.040 (0.009) ***
Cataract	-2.010 (2.541)	0.015 (0.025)	0.019 (0.025)	0.013 (0.015)
Gastric or peptic ulcer	-2.045 (3.398)	0.006 (0.026)	-0.063 (0.034)	-0.014 (0.019)
Bronchitis, emphysema, COPD	-4.100 (2.738)	-0.029 (0.022)	-0.069 (0.026) **	-0.025 (0.016)
Arrhythmias	-3.322 (1.901)	-0.017 (0.017)	-0.034 (0.018)	-0.024 (0.011) *
Cancer, leukaemia, lymphoma	-9.514 (3.282) **	0.000 (0.027)	-0.105 (0.034) **	-0.059 (0.020) **
Headache	-6.447 (2.468) **	-0.060 (0.031)	-0.067 (0.025) **	-0.039 (0.015) *
Urinary incontinence	-5.303 (2.617) *	-0.097 (0.031) **	-0.050 (0.027)	-0.032 (0.017)
Other cardiovascular disease	-5.603 (2.569) *	-0.046 (0.027)	-0.007 (0.026)	-0.019 (0.014)
Heart attack	-1.096 (3.752)	0.014 (0.046)	-0.016 (0.036)	-0.005 (0.021)
Coronary heart disease (angina)	-6.351 (3.247)	-0.063 (0.039)	-0.020 (0.032)	-0.006 (0.019)
Anxiety	-4.866 (2.218) *	-0.042 (0.023)	-0.081 (0.022) ***	-0.047 (0.013) ***
Depression	-2.712 (2.692)	-0.078 (0.028) **	-0.069 (0.025) **	-0.030 (0.015) *
Other mental health conditions	-9.657 (3.191) **	-0.104 (0.038) **	-0.072 (0.029) *	-0.049 (0.019) **
R^2	**0.2850**	**0.3946**	**0.3405**	**0.3578**

EQ VAS = EuroQol Visual Analogue Scale; PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions.

CI confidence intervals, COPD chronic obstructive pulmonary disease.

The significance of variables is marked as follows. '***': <0.001; '**': <0.01; '*': <0.05.

[a] Reference category. The normative category, or the category at one of the ends was chosen as the reference category.

[b] No reported condition was considered as the reference category.

5 Discussion

5.1 Comparison of EQ-5D-5L and 15D study

This study is the first to directly compare the EQ-5D-5L and 15D instruments in a general population sample. The sample's demographic diversity and representativeness enabled detailed subgroup analyses for physical and mental health conditions. Findings showed that EQ-5D-5L dimensions had a lower ceiling than the 15D dimensions, except in one corresponding dimension pair. Notably, the EQ-5D-5L index value exhibited a significantly larger ceiling than the 15D index value, aligning with prior research across various patient populations (70, 73, 78, 121, 142). Both indices showed reduced ceiling in physical and mental conditions subgroups compared to the total sample. Moreover, the EQ-5D-5L showed better overall relative informativity. Strong correlations were seen between the index values, consistent with previous studies (73, 79). Contrary to our expectations (132), the EQ-5D-5L anxiety/depression composite dimension correlated more with 15D depression dimension than with 15D distress. Both instruments effectively distinguished between healthy and non-healthy respondents with moderate to large effect sizes, with EQ-5D-5L generally yielding larger effect sizes across value sets.

While the EQ-5D-5L and 15D index values were comparable in healthy subgroups using Danish value sets, the EQ-5D-5L index values were substantially lower than 15D index values among respondents with any health conditions. Sensitivity analysis revealed that Norwegian 15D index values were significantly lower in 15 of 41 health conditions compared to Hungarian EQ-5D-5L index values, with minimal differences in others. This variation largely reflects differences in the value sets: the Danish 15D value set range is narrower, with a minimum index value of -0.516 in the Norwegian set, more closely aligned with either EQ-5D-5L value sets. Consequently, the Danish 15D value set has less capacity to differentiate more severe health states, which is also reflected in a poor ICC between Danish EQ-5D-5L and 15D index values, but a good ICC between Hungarian EQ-5D-5L and Norwegian 15D index values.

Several 15D dimensions, such as vision, hearing, eating, speech, excretion, and mental function, showed weak correlations with any EQ-5D-5L dimensions, indicating areas where EQ-5D-5L bolt-ons may enhance its measurement properties. This aligns with

prior research advocating for bolt-ons to cover these areas, including vision, hearing, speech, and cognition (94, 143-146). Since effective bolt-on development benefits from mixed-methods evidence across diverse populations (147), these findings offer a foundation for future EQ-5D bolt-on development efforts. Prior international studies have shown that bolt-ons can reduce ceiling in general populations (148-151), suggesting that bolt-ons could enrich the EQ-5D-5L's ability to assess HRQoL. However, it is essential to consider that adding bolt-ons might reduce standardisation efforts, potentially affecting the comparability of cost-effectiveness estimates across studies.

The EQ-5D-5L includes two composite dimensions: pain/discomfort and anxiety/depression, each covering two separate health dimensions. Pain/discomfort in the EQ-5D-5L aligns with the 15D discomfort and symptoms dimension, while anxiety/depression combines two separate dimensions of the 15D, depression ("sad, melancholic or depressed") and distress ("anxious, stressed or nervous"). Interestingly, EQ-5D-5L anxiety/depression correlated more strongly with 15D depression (0.690) than with 15D distress (0.642). Moreover, respondents reporting no problems with EQ-5D-5L anxiety/depression had markedly fewer problems with 15D depression (7.3%) than with 15D distress (20.6%). This pattern suggests that EQ-5D-5L anxiety/depression may better capture depression than anxiety, a view further supported by the subgroup analyses. Nevertheless, previous studies reported conflicting results: one indicated that respondents more frequently self-reported "no problems" with EQ-5D-5L anxiety/depression compared to when the dimension was split into two separate dimensions (152). Another study suggested the anxiety/depression dimension tended to capture the more severe aspect of both anxiety and depression (153).

5.2 EQ-5D-5L, PROPr, SF-6D, and 15D population norms studies

Our research provides population norms for several PAMs within the Hungarian adult population, marking the first studies to establish such norms for the 15D, EQ-5D-5L, PROPr, and SF-6D instruments in Hungary and, in the cases of 15D and PROPr, internationally. Specifically, the 15D study presented reference values for over 55 chronic physical and mental health conditions, while the EQ-5D-5L, PROPr, and SF-6D study offered index values for 30 chronic conditions. For the EQ-5D-5L, nearly 60% of participants reported health issues, predominantly pain/discomfort. Over 78% of

respondents reported at least some health issues on the 15D, with sleep being the most prevalent. For the SF-6D and PROPr, over 94% and 97% of respondents, respectively, indicated some health problems, with the most frequent issues being reduced vitality and sleep disturbances. Sociodemographic factors showed notable associations with index values. Female gender was associated with lower PROPr and SF-6D index values compared to males. However, no significant gender differences were observed with EQ-5D-5L and 15D. Age differences were also evident: for the 15D, older groups were associated with higher index values compared to the 18-24-year-old group, creating an inverse U-shaped curve, with index values peaking in the 45-54 age group and then gradually declining in older age groups. For the EQ-5D-5L and SF-6D, the youngest groups were associated with lower index values, but no differences were noted across the other age groups. This pattern also holds for the PROPr, where the 45-64 age group was associated with significantly higher index values. A higher level of education was associated with higher index values, except for the SF-6D, where no significant differences appeared. As for employment status, disability pensioners showed lower 15D index values than employed respondents, while students were associated with higher values. The EQ-5D-5L indicated that being unemployed or a disability pensioner was also associated with lower index values. Lastly, between 15.4% and 42.3% of chronic health condition groups were significantly associated with lower health index values, depending on the instrument.

Before our research, population reference data in Hungary were unavailable for several health domains, including vision, hearing, breathing, eating, speech, excretion, and sexual activities. Sensory functions, in particular, are notable as they cannot currently be assessed by any other generic PAM available in Hungarian. According to the EHIS and Eurostat data in 2019, 20.1% of the Hungarian population reported difficulties with walking, 16.6% with seeing, 17.9% with hearing, and 24.9% with usual activities (113, 154, 155). In our research, similar proportions were observed in the 15D domains: 21.8% for mobility, 27.8% for vision, 16.0% for hearing, and 21.7% for usual activities, closely matching national data except for slightly higher vision impairment and lower usual activity limitations. Results in the EQ-5D-5L, PROPr, and SF-6D domains varied, but generally showed a higher proportion of problems, reaching 29.6%, 39.1%, and 57.1%, respectively, for physical function issues. It is important to note differences in phrasing

for these health issues across the various PAMs as they may also influence the results. No population-level data existed for breathing, eating, speech, excretion, or sexual activities, so our research provides new insights into these domains among the Hungarian population. These findings can also serve as benchmarks for cost-effectiveness analyses in chronic conditions; for instance, data on breathing can support asthma or chronic obstructive pulmonary disease studies, vision for eye diseases, and hearing for hearing impairments.

Given the higher prevalence of chronic conditions in older adults–such as osteoarthritis, cardiovascular diseases, vision and hearing impairment, and dementia–one might expect lower HRQoL among the elderly compared to younger individuals. However, mean 15D index values rose with age, peaking in the 45-54 age group before declining in older groups. Additionally, an increase in reported problems was observed with age across five of the 15 domains: eating, speech, depression, distress, and mental function. Other instruments, such as the EQ-5D-5L (anxiety/depression), PROPr (depression), and SF-6D (mental health), also highlighted age-related decreases in mental health issues. Similar trends in the mental health domains of various HRQoL measures have been noted in previous studies (90, 156-158).

Considering the EQ-5D-5L's broader index value range (-0.848 to 1) compared to 15D (-0.516 to 1), PROPr (-0.022 to 0.954), and SF-6D (0.301 to 1) might suggest a specific order of sample means: SF-6D > PROPr > 15D > EQ-5D. However, the characteristics of each value sets, particularly the theoretical density distribution of values across the index value scale, also play a crucial role in determining mean values (159). Theoretical EQ-5D-5L, 15D and SF-6D values display symmetric distributions, with EQ-5D-5L covering the widest range. In contrast, PROPr values are skewed, clustering mostly between 0 and 0.5. In general population samples, values tend to be concentrated on the higher end of the index value scale. Consequently, EQ-5D-5L, with the highest density of values above 0.8, typically yields the highest mean, while PROPr, with most values below 0.5, results in the lowest mean. Additionally, since each value set was developed based on the preferences of different national populations, systematic variations may also reflect underlying socio-demographic, economic, and cultural differences (116).

The selection of the instrument is significantly shaped by the study's specific objectives, population characteristics, and context of use. Among the various options available, the EQ-5D-5L stands out as the most widely used and validated tool worldwide. It offers numerous country-specific value sets and demonstrates robust psychometric properties across many studies (52). As a result, it is often favoured in national HTA guidelines (46, 160) due to its extensiveness that effectively captures subtle changes in HRQoL. However, it has limitations in content validity, particularly concerning vision, hearing, and cognitive function. In contrast, instruments like the 15D, SF-6D, and PROPr explore health domains not fully covered by the EQ-5D-5L, making them potentially more appropriate for specific populations, including those with mental health issues or sleep disturbances. The 15D assesses 15 distinct health domains, offering a more nuanced view of HRQoL. However, its multidimensional nature may result in inflated index values for individuals with severe health conditions, which may distort results. PROPr is a newer PAM that employs advanced psychometric methods and includes domains such as cognition and sleep, which are not represented in the EQ-5D-5L. Nonetheless, its validity and reliability remain under investigation, with concerns regarding positively worded items (e.g., "Refreshing sleep"), the valuation methods used, and face validity, particularly regarding mean index values around 0.5 in general population samples (54, 159, 161). Regarding the SF-6D, it is important to note that our research utilised the SF-36v1 to estimate index values for the SF-6Dv1. A newer version, the SF-6Dv2, has been developed to address earlier criticisms, such as unclear severity ordering in the physical functioning domain and the positively phrased vitality domain compared to the other domains (162). The SF-6Dv2 employs a discrete choice experiment with a duration-based value set for the UK, contrasting with the standard gamble approach of the SF-6Dv1 (163). Despite these updates, studies indicate that the SF-6Dv1 maintains comparable validity to EQ-5D-5L across diverse populations (164-167). Each tool has distinct strengths and weaknesses, highlighting the necessity of selecting the most suitable instrument based on the target population and specific evaluation objectives. Given its broader index value range, stronger construct validity, and responsiveness, the EQ-5D-5L is deemed more suitable for HTA purposes than the 15D, SF-6Dv1 or PROPr (54, 168-170). Additionally, the number of items in each instrument is a crucial factor: EQ-5D-5L has 6 items (including the EQ VAS), 15D contains 15 items, PROPr requires at

least 14, while SF-6D can have either 12 (SF-12) or 36 (SF-36) items. In clinical trials, longer questionnaires may increase patient burden and the likelihood of missing responses.

5.3 Limitations of these studies

The findings of these studies are subject to several limitations. First, the sample composition in each study differed from that of the general Hungarian population: a significantly higher proportion of respondents self-reported chronic illnesses (e.g., 71.5% and 67.4% in our studies, compared to 48.0% in the general population according to the EHIS) (113). This disparity may be due to the more detailed nature of our questionnaires, which included an extensive list of health conditions, covering several physical and mental health conditions and recognizing several addictions as health conditions, in line with DSM-5 guidelines. Additionally, certain physical and mental health conditions with low prevalence were excluded from modelling, potentially affecting the results' comprehensiveness. Second, data were collected exclusively from online panel respondents, introducing potential selection bias, especially among older adults and individuals from low socioeconomic backgrounds who may be underrepresented in online surveys. Furthermore, our sample included a limited number of respondents aged 75 years or older, who are less likely to use internet regularly or have internet access (171-173), reducing the generalizability of findings for this age group. Third, due to the lack of a Hungarian-specific value set for the 15D, PROPr, and SF-6D, we used country-specific value sets from Denmark, Norway, the United States, and the United Kingdom. These value sets may not fully reflect Hungarian population preferences, potentially influencing the validity of the results in a Hungarian context. Fourth, the fixed order of the instruments may have influenced responses, although prior research suggests that order effects in lengthy surveys tend to be minimal (174-176). Additionally, the cross-sectional design of the studies did not allow for the assessment of responsiveness or test-retest reliability. Finally, data collection occurred during the COVID-19 pandemic, which may have impacted participants' responses, particularly among younger generations (177). However, pandemic restrictions were relatively low during the data collection period in Hungary (178, 179), and previous studies have shown comparable self-reported HRQoL metrics pre- and post-pandemic (180).

5.4 Future challenges and research priorities

The findings of this thesis open several promising avenues for future research, addressing emerging challenges and filling critical gaps in the field.

A key priority is exploring demographic differences in HRQoL, particularly among the 65+ age group. With global population ageing and increased use of PAMs in these age groups, such as the capability-oriented ICEpop CAPability measure for Older people (ICECAP-O) and Quality of Life - Aged Care Consumers (QOL-ACC) (181, 182), future studies could provide deeper insights into the unique challenges faced by older adults, informing targeted policies and interventions. Another key direction involves validating EQ-5D-5L bolt-on dimensions across diverse patient populations. These additions can improve the precision of HRQoL measures, ensuring relevance to varied patient needs and supporting more comprehensive healthcare assessments (147). Diversifying data collection methods also remains a pressing need. Heavy reliance on online questionnaires risks excluding individuals with limited internet access or digital literacy. Employing alternative approaches, such as face-to-face interviews, telephone surveys, or mixed approaches, can improve inclusivity, particularly for marginalised populations, older adults, and underdeveloped regions. Finally, the growing prevalence of mental health challenges among youth demands immediate attention. The results of this thesis highlight the urgency of investigating underlying causes (e.g., economic insecurity, social media influences), while assessing the effectiveness of existing interventions. Prioritising the development of innovative, evidence-based strategies can ensure that future generations receive the support they need.

These proposed research directions not only build on the findings of this thesis but also address pressing societal challenges. They offer opportunities to deepen our understanding, improve interventions, and support the development of adaptive solutions. By remaining responsive to evolving public health needs, future research can play an important role in building healthier and more resilient populations.

6 Conclusions

This thesis contributes to the comparative understanding of four generic preference-accompanied HRQoL measures: EQ-5D-5L, 15D, PROPr, and SF-6D. Through three separate studies, we compared the measurement properties and developed the population norms of these instruments.

Comparison of EQ-5D-5L and 15D study

The first study is a pioneering effort to compare the descriptive systems and index values of the EQ-5D-5L and 15D within a representative general population sample. Despite the EQ-5D-5L containing 10 fewer dimensions, it outperformed the 15D in several key areas, including ceiling, informativity, and known-groups validity. Certain 15D dimensions, such as vision, hearing, and mental function, demonstrated relatively weak correlations with the EQ-5D-5L dimensions, indicating opportunities for potential enhancement to the EQ-5D-5L through bolt-on dimensions. Both instruments effectively distinguished healthy and non-healthy respondents, but the EQ-5D-5L consistently produced larger effect sizes across most groups. These findings suggest that the more concise EQ-5D-5L is an effective tool for capturing relevant HRQoL areas and that enhancements could further address specific areas where 15D showed greater sensitivity.

15D population norms study

The second study marks the first development of 15D population norms in any country, providing mean index values for over 55 chronic diseases among the Hungarian general population. More than three-quarters of participants experienced problems in at least one 15D domain, with difficulties related to sleeping, vitality and distress being the most prevalent. The results revealed substantial differences in HRQoL between physical and mental conditions; individuals with mental health conditions reported lower mean index values. Notably, mean 15D index values increased with age, peaking in the 45–54 age group before declining in older populations. At the same time, the younger generation also reported more problems with mental function, depression, and distress. Respondents with higher education levels, student status, and being in a domestic partnership or married were associated with higher index values. Several physical and mental health conditions also showed significant associations with the 15D index value.

EQ-5D-5L, PROPr and SF-6D population norms study

The third study developed the first set of population norms for the EQ-5D-5L, PROPr, and SF-6D simultaneously among the Hungarian general population, providing health index values for 30 chronic physical and mental health conditions. Nearly two-thirds of respondents reported health problems on the EQ-5D-5L, with pain/discomfort being the most commonly reported problem. In contrast, the majority of the participants reported difficulties on the PROPr and SF-6D, with sleep disturbances and vitality frequently cited. The analysis revealed notable patterns in HRQoL across demographic groups, showing that males had higher index values across all measures and females reported more health problems in corresponding domains. Among the three instruments, EQ-5D-5L yielded the highest index values, while PROPr produced the lowest. Several sociodemographic and health-related factors–including age, gender, education, employment, income, physical activity, medication use, and BMI–were associated with health index values.

General conclusions

Overall, this thesis highlights the complexity of HRQoL measurement and the critical role of selecting the appropriate instrument for specific contexts. The EQ-5D-5L, with its simplicity and broad applicability, proves effective in general population settings, while the 15D, PROPr, and SF-6D might offer more nuanced insights, particularly in clinical environments. The establishment of Hungarian population norms for these instruments provides a valuable foundation for future research, setting a benchmark for patient populations.

7 Summary

This PhD thesis assessed the psychometric performance and established population norms for generic preference-accompanied HRQoL measures among the Hungarian general population, using data collected in 2020-2021. The thesis comprised three separate, but related studies.

The first study compared the EQ-5D-5L and 15D descriptive systems and index values, marking the first known comparison in a general population sample. While the EQ-5D-5L had better relative informativity than the 15D (0.51–0.70 vs. 0.44–0.69) in most corresponding dimensions, it also showed a higher ceiling in its index value (36% vs. 21%). Both instruments effectively distinguished healthy and non-healthy respondents, with the EQ-5D-5L yielding larger effect sizes in 88-93% of cases.

The second study established population norms for the 15D in Hungary based on a large representative general population sample. Problems were most commonly reported in sleeping (50.7%), vitality (49.2%), and distress (43.6%). The mean 15D index value was 0.810. The 15D index values exhibited a slight inverse U-shaped curve with age. Individuals with mental health conditions had, on average, lower index values (0.299-0.757) compared to those with physical conditions (0.557-0.764).

The third study developed population norms for the EQ-5D-5L, PROPr and SF-6D measures in Hungary. Respondents reporting problems ranged between 8-44% on the EQ-5D-5L, 39–94% on PROPr and 38–87% on the SF-6D. Problems related to physical function, self-care, usual activities/role limitations and pain increased with age, while mental health problems decreased. Respondents indicated the fewest problems on the EQ-5D-5L and the most on the SF-6D across nearly all domains. Mean EQ-5D-5L, PROPr, and SF-6D index values were 0.900, 0.535, and 0.755. Factors such as female gender (PROPr, SF-6D), lower education level (EQ-5D-5L, PROPr), being unemployed or a disability pensioner (EQ-5D-5L), being underweight or obese (SF-6D), lack of physical exercise (all) and polypharmacy (all) were associated with lower index values. PROPr had the lowest mean index values and EQ-5D-5L the highest in 28/30 chronic conditions.

Overall, this PhD thesis highlights the differences between widely used generic preference-accompanied measures and provides reference values essential for informing decision-making about health care in Hungary.

8 References

1. Karimi M, Brazier J. Health, Health-Related Quality of Life, and Quality of Life: What is the Difference? Pharmacoeconomics. 2016;34(7):645-9.
2. World Health Organization. Constitution of the World Health Organization. Basic Documents. 49 ed. Geneva: World Health Organization; 2020.
3. Testa MA, Simonson DC. Assessment of quality-of-life outcomes. N Engl J Med. 1996;334(13):835-40.
4. Cella DF. Quality of life: concepts and definition. J Pain Symptom Manage. 1994;9(3):186-92.
5. McSweeny AJ, Creer TL. Health-related quality-of-life assessment in medical care. Dis Mon. 1995;41(1):1-71.
6. Revicki DA, Kleinman L, Cella D. A history of health-related quality of life outcomes in psychiatry. Dialogues Clin Neurosci. 2014;16(2):127-35.
7. Torrance GW. Measurement of health state utilities for economic appraisal. J Health Econ. 1986;5(1):1-30.
8. Torrance GW. Utility approach to measuring health-related quality of life. J Chronic Dis. 1987;40(6):593-603.
9. Torrance GW. Utility measurement in healthcare: the things I never got to. Pharmacoeconomics. 2006;24(11):1069-78.
10. Torrance GW. Social preferences for health states: An empirical evaluation of three measurement techniques. Socio-Economic Planning Sciences. 1976;10(3):129-36.
11. Richardson JRJ, Mckie JR, Bariola EJ. Multiattribute utility instruments and their use. In: Culyer AJ, editor. Encylopedia of Health Economics, Volume 2. San Diego CA USA: Elsevier; 2014. p. 341 - 57.
12. Weinstein MC, Torrance G, McGuire A. QALYs: the basics. Value Health. 2009;12 Suppl 1:S5-9.
13. Whitehead SJ, Ali S. Health outcomes in economic evaluation: the QALY and utilities. Br Med Bull. 2010;96:5-21.
14. Weinstein MC. A QALY is a QALY is a QALY — Or is it? Journal of Health Economics. 1988;7(3):289-90.

15. Pettitt D, Raza S, Naughton B, Roscoe A, Ramakrishnan A, Ali A, et al. The limitations of QALY: a literature review. Journal of Stem Cell Research and Therapy. 2016;6(4):1000334.

16. National Institute for Health and Care Excellence. NICE health technology evaluations: the manual https://www.nice.org.uk/process/pmg36/resources/nice-health-technology-evaluations-the-manual-pdf-72286779244741. Published 2022. Accessed September 18, 2024.

17. Guidelines for the economic evaluation of health technologies: Canada. 4th ed. ed. Ottawa: CADTH2017 Mar.

18. Australian Government. Guidelines for preparing a submission to the Pharmaceutical Benefits Advisory Committee (Version 5.0). https://pbac.pbs.gov.au/content/information/files/pbac-guidelines-version-5.pdf. Published 2016 Sep. Accessed September 18, 2024.

19. Emberi Erőforrások Minisztériuma. Az Emberi Erőforrások Minisztériuma egészségügyi szakmai irányelve az egészség-gazdaságtani elemzések készítéséhez és értékeléséhez. Egészségügyi Közlöny. 2021;71(21):2178-200.

20. Jackowski D, Guyatt G. A Guide to Health Measurement. Clinical Orthopaedics and Related Research®. 2003;413.

21. Patrick DL, Deyo RA. Generic and disease-specific measures in assessing health status and quality of life. Med Care. 1989;27(3 Suppl):S217-32.

22. Rowen D, Brazier J, Ara R, Azzabi Zouraq I. The Role of Condition-Specific Preference-Based Measures in Health Technology Assessment. Pharmacoeconomics. 2017;35(Suppl 1):33-41.

23. Churruca K, Pomare C, Ellis LA, Long JC, Henderson SB, Murphy LED, et al. Patient-reported outcome measures (PROMs): A review of generic and condition-specific measures and a discussion of trends and issues. Health Expect. 2021;24(4):1015-24.

24. Brazier J, Ara R, Rowen D, Chevrou-Severac H. A Review of Generic Preference-Based Measures for Use in Cost-Effectiveness Models. Pharmacoeconomics. 2017;35(Suppl 1):21-31.

25. EuroQol Group. EuroQol--a new facility for the measurement of health-related quality of life. Health Policy. 1990;16(3):199-208.

26. Herdman M, Gudex C, Lloyd A, Janssen M, Kind P, Parkin D, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). Qual Life Res. 2011;20(10):1727-36.
27. Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. J Health Econ. 2002;21(2):271-92.
28. Feeny D, Furlong W, Torrance GW, Goldsmith CH, Zhu Z, DePauw S, et al. Multiattribute and single-attribute utility functions for the health utilities index mark 3 system. Med Care. 2002;40(2):113-28.
29. Kaplan RM, Bush JW, Berry CC. Health status: types of validity and the index of well-being. Health Serv Res. 1976;11(4):478-507.
30. Richardson J, Atherton Day N, Peacock S, Iezzi A. Measurement of the quality of life for economic evaluation and the Assessment of Quality of Life (AQoL) Mark 2 instrument. Australian Economic Review. 2004;37(1):62-88.
31. Young TA, Yang Y, Brazier JE, Tsuchiya A. The use of rasch analysis in reducing a large condition-specific instrument for preference valuation: the case of moving from AQLQ to AQL-5D. Med Decis Making. 2011;31(1):195-210.
32. Sundaram M, Smith MJ, Revicki DA, Miller LA, Madhavan S, Hobbs G. Estimation of a valuation function for a diabetes mellitus-specific preference-based measure of health: the Diabetes Utility Index. Pharmacoeconomics. 2010;28(3):201-16.
33. Grimison PS, Simes RJ, Hudson HM, Stockler MR. Deriving a patient-based utility index from a cancer-specific quality of life questionnaire. Value Health. 2009;12(5):800-7.
34. Mulhern B, Rowen D, Jacoby A, Marson T, Snape D, Hughes D, et al. The development of a QALY measure for epilepsy: NEWQOL-6D. Epilepsy Behav. 2012;24(1):36-43.
35. Brazier J, Czoski-Murray C, Roberts J, Brown M, Symonds T, Kelleher C. Estimation of a preference-based index from a condition-specific measure: the King's Health Questionnaire. Med Decis Making. 2008;28(1):113-26.
36. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473-83.
37. The WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. Psychol Med. 1998;28(3):551-8.

38. Hunt SM, McEwen J, McKenna SP. Measuring health status: a new tool for clinicians and epidemiologists. J R Coll Gen Pract. 1985;35(273):185-8.

39. Bergner M, Bobbitt RA, Carter WB, Gilson BS. The Sickness Impact Profile: development and final revision of a health status measure. Med Care. 1981;19(8):787-805.

40. Finlay AY, Khan GK. Dermatology Life Quality Index (DLQI)--a simple practical measure for routine clinical use. Clin Exp Dermatol. 1994;19(3):210-6.

41. The DCCT Research Group. Reliability and validity of a diabetes quality-of-life measure for the diabetes control and complications trial (DCCT). Diabetes Care. 1988;11(9):725-32.

42. Stewart WF, Lipton RB, Dowson AJ, Sawyer J. Development and testing of the Migraine Disability Assessment (MIDAS) Questionnaire to assess headache-related disability. Neurology. 2001;56(6 Suppl 1):S20-8.

43. Jones PW, Quirk FH, Baveystock CM, Littlejohns P. A self-complete measure of health status for chronic airflow limitation. The St. George's Respiratory Questionnaire. Am Rev Respir Dis. 1992;145(6):1321-7.

44. Juniper EF, Guyatt GH, Epstein RS, Ferrie PJ, Jaeschke R, Hiller TK. Evaluation of impairment of health related quality of life in asthma: development of a questionnaire for use in clinical trials. Thorax. 1992;47(2):76-83.

45. EuroQol Research Foundation. EQ-5D-5L User Guide. https://euroqol.org/publications/user-guides. Published 2019. Accessed December 10, 2024.

46. Kennedy-Martin M, Slaap B, Herdman M, van Reenen M, Kennedy-Martin T, Greiner W, et al. Which multi-attribute utility instruments are recommended for use in cost-utility analysis? A review of national health technology assessment (HTA) guidelines. Eur J Health Econ. 2020;21(8):1245-57.

47. Rencz F, Gulácsi L, Drummond M, Golicki D, Prevolnik Rupel V, Simon J, et al. EQ-5D in Central and Eastern Europe: 2000-2015. Qual Life Res. 2016;25(11):2693-710.

48. Buchholz I, Janssen MF, Kohlmann T, Feng YS. A Systematic Review of Studies Comparing the Measurement Properties of the Three-Level and Five-Level Versions of the EQ-5D. Pharmacoeconomics. 2018;36(6):645-61.

49. Rowen D, Mukuria C, McDool E. A Systematic Review of the Methodologies and Modelling Approaches Used to Generate International EQ-5D-5L Value Sets. Pharmacoeconomics. 2022;40(9):863-82.
50. Rencz F, Brodszky V, Gulácsi L, Golicki D, Ruzsa G, Pickard AS, et al. Parallel Valuation of the EQ-5D-3L and EQ-5D-5L by Time Trade-Off in Hungary. Value Health. 2020;23(9):1235-45.
51. Rencz F, Ruzsa G, Bató A, Yang Z, Finch AP, Brodszky V. Value Set for the EQ-5D-Y-3L in Hungary. Pharmacoeconomics. 2022;40(Suppl 2):205-15.
52. Feng YS, Kohlmann T, Janssen MF, Buchholz I. Psychometric properties of the EQ-5D-5L: a systematic review of the literature. Qual Life Res. 2021;30(3):647-73.
53. Szende A, Leidy NK, Ståhl E, Svensson K. Estimating health utilities in patients with asthma and COPD: evidence on the performance of EQ-5D and SF-6D. Qual Life Res. 2009;18(2):267-72.
54. Rencz F, Brodszky V, Janssen MF. A Direct Comparison of the Measurement Properties of EQ-5D-5L, PROMIS-29+2 and PROMIS Global Health Instruments and EQ-5D-5L and PROPr Utilities in a General Population Sample. Value Health. 2023;26(7):1045-56.
55. Poór AK, Rencz F, Brodszky V, Gulácsi L, Beretzky Z, Hidvégi B, et al. Measurement properties of the EQ-5D-5L compared to the EQ-5D-3L in psoriasis patients. Qual Life Res. 2017;26(12):3409-19.
56. Rencz F, Lakatos PL, Gulácsi L, Brodszky V, Kürti Z, Lovas S, et al. Validity of the EQ-5D-5L and EQ-5D-3L in patients with Crohn's disease. Qual Life Res. 2019;28(1):141-52.
57. Tamási B, Brodszky V, Péntek M, Gulácsi L, Hajdu K, Sárdy M, et al. Validity of the EQ-5D in patients with pemphigus vulgaris and pemphigus foliaceus. Br J Dermatol. 2019;180(4):802-9.
58. Gergely LH, Gáspár K, Brodszky V, Kinyó Á, Szegedi A, Remenyik É, et al. Validity of EQ-5D-5L, Skindex-16, DLQI and DLQI-R in patients with hidradenitis suppurativa. J Eur Acad Dermatol Venereol. 2020;34(11):2584-92.
59. Bató A, Brodszky V, Gergely LH, Gáspár K, Wikonkál N, Kinyó Á, et al. The measurement performance of the EQ-5D-5L versus EQ-5D-3L in patients with hidradenitis suppurativa. Qual Life Res. 2021;30(5):1477-90.

60. Rencz F, Mukuria C, Bató A, Poór AK, Finch AP. A qualitative investigation of the relevance of skin irritation and self-confidence bolt-ons and their conceptual overlap with the EQ-5D in patients with psoriasis. Qual Life Res. 2022;31(10):3049-60.
61. Koszorú K, Hajdu K, Brodszky V, Szabó Á, Borza J, Bodai K, et al. General and Skin-Specific Health-Related Quality of Life in Patients With Atopic Dermatitis Before and During the COVID-19 Pandemic. Dermatitis. 2022;33(6s):S92-s103.
62. Koszorú K, Hajdu K, Brodszky V, Bató A, Gergely LH, Kovács A, et al. Comparing the psychometric properties of the EQ-5D-3L and EQ-5D-5L descriptive systems and utilities in atopic dermatitis. Eur J Health Econ. 2023;24(1):139-52.
63. Sintonen H. The 15D instrument of health-related quality of life: properties and applications. Ann Med. 2001;33(5):328-36.
64. Sintonen H. 15D instrument. http://www.15d-instrument.net/15d/. Accessed July 10, 2024.
65. Sintonen H. The 15D-measure of health-related quality of life. II. Feasibility, reliability and validity of its valuation system. National Centre for Health Program Evaluation, Working Paper 42, Melbourne. 1995.
66. Wittrup-Jensen KU, Pedersen KM. Modelling Danish weights for the 15D quality of life questionnaire by applying multi-attribute utility theory (MAUT): Syddansk Universitet; 2008.
67. Michel YA, Augestad LA, Rand K. Comparing 15D Valuation Studies in Norway and Finland-Challenges When Combining Information from Several Valuation Tasks. Value Health. 2018;21(4):462-70.
68. Michel YA, Augestad LA, Barra M, Rand K. A Norwegian 15D value algorithm: proposing a new procedure to estimate 15D value algorithms. Qual Life Res. 2019;28(5):1129-43.
69. Stavem K. Reliability, validity and responsiveness of two multiattribute utility measures in patients with chronic obstructive pulmonary disease. Qual Life Res. 1999;8(1-2):45-54.
70. Stavem K, Bjørnaes H, Lossius MI. Properties of the 15D and EQ-5D utility measures in a community sample of people with epilepsy. Epilepsy Res. 2001;44(2-3):179-89.

71. Stavem K, Frøland SS, Hellum KB. Comparison of preference-based utilities of the 15D, EQ-5D and SF-6D in patients with HIV/AIDS. Qual Life Res. 2005;14(4):971-80.
72. Moock J, Kohlmann T. Comparing preference-based quality-of-life measures: results from rehabilitation patients with musculoskeletal, cardiovascular, or psychosomatic disorders. Qual Life Res. 2008;17(3):485-95.
73. Vainiola T, Pettilä V, Roine RP, Räsänen P, Rissanen AM, Sintonen H. Comparison of two utility instruments, the EQ-5D and the 15D, in the critical care setting. Intensive Care Med. 2010;36(12):2090-3.
74. Gunel MK, Tuzun EH, Aki E, Eker L. Investigation of Validity, Reliability and Acceptability of the Turkish Version of the 15D Questionnaire Health-Related Quality of Life on the People with Visual Impairment. 2010.
75. Okamoto N, Hisashige A, Tanaka Y, Kurumatani N. Development of the Japanese 15D instrument of health-related quality of life: verification of reliability and validity among elderly people. PLoS One. 2013;8(4):e61721.
76. García-Gordillo M, del Pozo-Cruz B, Adsuar JC, Sánchez-Martínez FI, Abellán-Perpiñán JM. Validation and comparison of 15-D and EQ-5D-5L instruments in a Spanish Parkinson's disease population sample. Qual Life Res. 2014;23(4):1315-26.
77. Kattainen E, Sintonen H, Kettunen R, Meriläinen P. Health-related quality of life of coronary artery bypass grafting and percutaneous transluminal coronary artery angioplasty patients: 1-year follow-up. Int J Technol Assess Health Care. 2005;21(2):172-9.
78. Heiskanen J, Tolppanen AM, Roine RP, Hartikainen J, Hippeläinen M, Miettinen H, et al. Comparison of EQ-5D and 15D instruments for assessing the health-related quality of life in cardiac surgery patients. Eur Heart J Qual Care Clin Outcomes. 2016;2(3):193-200.
79. Vartiainen P, Mäntyselkä P, Heiskanen T, Hagelberg N, Mustola S, Forssell H, et al. Validation of EQ-5D and 15D in the assessment of health-related quality of life in chronic pain. Pain. 2017;158(8):1577-85.
80. Altman D, Geale K, Falconer C, Morcos E. A generic health-related quality of life instrument for assessing pelvic organ prolapse surgery: correlation with condition-specific outcome measures. Int Urogynecol J. 2018;29(8):1093-9.

81. Cella D, Choi SW, Condon DM, Schalet B, Hays RD, Rothrock NE, et al. PROMIS(®) Adult Health Profiles: Efficient Short-Form Measures of Seven Health Domains. Value Health. 2019;22(5):537-44.

82. Reeve BB, Hays RD, Bjorner JB, Cook KF, Crane PK, Teresi JA, et al. Psychometric evaluation and calibration of health-related quality of life item banks: plans for the Patient-Reported Outcomes Measurement Information System (PROMIS). Med Care. 2007;45(5 Suppl 1):S22-31.

83. Cella D, Riley W, Stone A, Rothrock N, Reeve B, Yount S, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. J Clin Epidemiol. 2010;63(11):1179-94.

84. Hays RD, Spritzer KL, Schalet BD, Cella D. PROMIS(®)-29 v2.0 profile physical and mental health summary scores. Qual Life Res. 2018;27(7):1885-91.

85. Dewitt B, Feeny D, Fischhoff B, Cella D, Hays RD, Hess R, et al. Estimation of a Preference-Based Summary Score for the Patient-Reported Outcomes Measurement Information System: The PROMIS(®)-Preference (PROPr) Scoring System. Med Decis Making. 2018;38(6):683-98.

86. Hanmer J. Measuring population health: association of self-rated health and PROMIS measures with social determinants of health in a cross-sectional survey of the US population. Health Qual Life Outcomes. 2021;19(1):221.

87. Zhang J, Dewitt B, Tang E, Breitner D, Saqib M, Li D, et al. Evaluation of PROMIS Preference Scoring System (PROPr) in Patients Undergoing Hemodialysis or Kidney Transplant. Clin J Am Soc Nephrol. 2021;16(9):1328-36.

88. Pan T, Mulhern B, Viney R, Norman R, Tran-Duy A, Hanmer J, et al. Evidence on the relationship between PROMIS-29 and EQ-5D: a literature review. Qual Life Res. 2022;31(1):79-89.

89. Mulhern BJ, Pan T, Norman R, Tran-Duy A, Hanmer J, Viney R, et al. Understanding the measurement relationship between EQ-5D-5L, PROMIS-29 and PROPr. Qual Life Res. 2023;32(11):3147-60.

90. Jenei B, Bató A, Mitev AZ, Brodszky V, Rencz F. Hungarian PROMIS-29+2: psychometric properties and population reference values. Qual Life Res. 2023;32(8):2179-94.

91. Nagy Z, Kiss N, Szigeti M, Áfra J, Lekka N, Misik F, et al. Construct validity of the Hungarian Version of the Patient-Reported Outcomes Measurement Information System (PROMIS)-29 Profile Among Patients With Low Back Pain. World Neurosurg. 2024;181:e55-e66.
92. Bató A, Brodszky V, Mitev AZ, Jenei B, Rencz F. Psychometric properties and general population reference values for PROMIS Global Health in Hungary. Eur J Health Econ. 2024;25(4):549-62.
93. Wang L, Poder TG. A systematic review of SF-6D health state valuation studies. J Med Econ. 2023;26(1):584-93.
94. Longworth L, Yang Y, Young T, Mulhern B, Hernández Alava M, Mukuria C, et al. Use of generic and condition-specific measures of health-related quality of life in NICE decision-making: a systematic review, statistical modelling and survey. Health Technol Assess. 2014;18(9):1-224.
95. Brazier J, Connell J, Papaioannou D, Mukuria C, Mulhern B, Peasgood T, et al. A systematic review, psychometric analysis and qualitative assessment of generic preference-based measures of health in mental health populations and the estimation of mapping functions from widely used specific measures. Health Technol Assess. 2014;18(34):vii-viii, xiii-xxv, 1-188.
96. Zhang A, Mao Z, Wang Z, Wu J, Luo N, Wang P. Comparing measurement properties of EQ-5D and SF-6D in East and South-East Asian populations: a scoping review. Expert Rev Pharmacoecon Outcomes Res. 2023;23(5):449-68.
97. Szabó Á, Brodszky V, Rencz F. Comparing EQ-5D-5L, PROPr, SF-6D and TTO utilities in patients with chronic skin diseases. Eur J Health Econ. 2024.
98. Streiner DL, Norman GR, Cairney J. Health Measurement Scales: A practical guide to their development and use: Oxford University Press; 2014 01 Jan 2015.
99. Hays RD, Anderson R, Revicki D. Psychometric considerations in evaluating health-related quality of life measures. Qual Life Res. 1993;2(6):441-9.
100. Terwee CB, Prinsen CAC, Chiarotto A, Westerman MJ, Patrick DL, Alonso J, et al. COSMIN methodology for evaluating the content validity of patient-reported outcome measures: a Delphi study. Qual Life Res. 2018;27(5):1159-70.
101. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN checklist for assessing the methodological quality of studies on

measurement properties of health status measurement instruments: an international Delphi study. Qual Life Res. 2010;19(4):539-49.

102. Mokkink LB, Prinsen C, Patrick DL, Alonso J, Bouter LM, de Vet HC, et al. COSMIN Study Design checklist for Patient-reported outcome measurement instruments. https://www.cosmin.nl/wp-content/uploads/COSMIN-study-designing-checklist_final.pdf. Published 2019. Accessed August 5, 2024.

103. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007;60(1):34-42.

104. Janssen B, Szende A, Ramos-Goñi JM. Data and Methods. In: Szende A, Janssen B, Cabases J, editors. Self-Reported Population Health: An International Perspective based on EQ-5D. Dordrecht: Springer Netherlands; 2014. p. 7-17.

105. Stewart AL, Greenfield S, Hays RD, Wells K, Rogers WH, Berry SD, et al. Functional status and well-being of patients with chronic conditions. Results from the Medical Outcomes Study. Jama. 1989;262(7):907-13.

106. Hawthorne G, Osborne R. Population norms and meaningful differences for the Assessment of Quality of Life (AQoL) measure. Aust N Z J Public Health. 2005;29(2):136-42.

107. Hopman WM, Towheed T, Anastassiades T, Tenenhouse A, Poliquin S, Berger C, et al. Canadian normative data for the SF-36 health survey. Canadian Multicentre Osteoporosis Study Research Group. Cmaj. 2000;163(3):265-71.

108. EuroQol Group. EQ-5D-5L population norm studies. https://euroqol.org/information-and-support/resources/population-norms/. Accessed September 18, 2024.

109. Szende A, Németh R. [Health-related quality of life of the Hungarian population]. Orv Hetil. 2003;144(34):1667-74.

110. Inotai A, Nagy D, Kaló Z, Vokó Z. Population-level norm values by EQ-5D-3L in Hungary - a comparison of survey results from 2022 with those from 2000. Qual Life Res. 2024;33(9):2417-28.

111. Czimbalmos Á, Nagy Z, Varga Z, Husztik P. Páciens megelégedettségi vizsgálat SF-36 kérdőívvel, a magyarországi normálértékek meghatározása. Népegészségügy. 1999;80(1):4-19.

112. Brazier J. Is the EQ-5D fit for purpose in mental health? Br J Psychiatry. 2010;197(5):348-9.

113. Hungarian Central Statistical Office. Tehetünk az egészségünkért – ELEF2019 gyorsjelentés. https://www.ksh.hu/docs/hun/xftp/idoszaki/elef/te_2019/index.html. Accessed March 11, 2022.

114. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington, DC2013.

115. Jensen CE, Sørensen SS, Gudex C, Jensen MB, Pedersen KM, Ehlers LH. The Danish EQ-5D-5L Value Set: A Hybrid Model Using cTTO and DCE Data. Appl Health Econ Health Policy. 2021;19(4):579-91.

116. Roudijk B, Donders ART, Stalmeier PFM. Cultural Values: Can They Explain Differences in Health Utilities between Countries? Med Decis Making. 2019;39(5):605-16.

117. McDool E, Mukuria C, Brazier J. A Comparison of the SF-6Dv2 and SF-6D UK Utility Values in a Mixed Patient and Healthy Population. Pharmacoeconomics. 2021;39(8):929-40.

118. Brazier J, Roberts J, Tsuchiya A, Busschbach J. A comparison of the EQ-5D and SF-6D across seven patient groups. Health Econ. 2004;13(9):873-84.

119. Janssen MF, Bonsel GJ, Luo N. Is EQ-5D-5L Better Than EQ-5D-3L? A Head-to-Head Comparison of Descriptive Systems and Value Sets from Seven Countries. Pharmacoeconomics. 2018;36(6):675-97.

120. Janssen MFB, Birnie E, Bonsel GJ. Evaluating the discriminatory power of EQ-5D, HUI2 and HUI3 in a US general population survey using Shannon's indices. Qual Life Res. 2007;16(5):895-904.

121. Lunde L. Can EQ-5D and 15D be used interchangeably in economic evaluations? Assessing quality of life in post-stroke patients. Eur J Health Econ. 2013;14(3):539-50.

122. Shannon CE. A mathematical theory of communication. The Bell System Technical Journal. 1948;27(3):379-423.

123. Shannon C, Weaver W. The mathematical theory of communication. Urbana: Univ. of Illinois Press; 1949. p. 104-7.

124. Janssen MF, Birnie E, Haagsma JA, Bonsel GJ. Comparing the standard EQ-5D three-level system with a five-level version. Value Health. 2008;11(2):275-84.

125. Koo TK, Li MY. A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. J Chiropr Med. 2016;15(2):155-63.

126. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986;1(8476):307-10.

127. Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychol Bull. 1979;86(2):420-8.

128. Cicchetti DV. Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychological assessment. 1994;6(4):284.

129. Swinscow TDV, Campbell MJ. Statistics at Square One. London, United Kingdom: BMJ; 2002.

130. Cohen J. A power primer. Psychological Bulletin. 1992;112(1):155-9.

131. Devlin N, Parkin D, Janssen B. Analysis of EQ-5D Profiles. Methods for Analysing and Reporting EQ-5D Data. Cham (CH): Springer; 2020. p. 23-49.

132. Rencz F, Janssen MF. Analyzing the Pain/Discomfort and Anxiety/Depression Composite Domains and the Meaning of Discomfort in the EQ-5D: A Mixed-Methods Study. Value Health. 2022;25(12):2003-16.

133. Rencz F, Janssen MF. Testing the Psychometric Properties of 9 Bolt-Ons for the EQ-5D-5L in a General Population Sample. Value Health. 2024;27(7):943-54.

134. Hungarian Central Statistical Office. Microcensus 2016. https://www.ksh.hu/docs/eng/xftp/idoszaki/microcensus2016/microcensus_2016_3.pdf. Accessed 6 Oct 2022.

135. Nikl A, Janssen MF, Jenei B, Brodszky V, Rencz F. Population Norms for the EQ-5D-5L, PROPr and SF-6D in Hungary. Pharmacoeconomics. 2024;42(5):583-603.

136. Szende A, Janssen B, Cabases J. Self-Reported Population Health: An International Perspective based on EQ-5D. In: Szende A, Janssen B, Cabases J, editors. Dordrecht (NL): Springer; 2014.

137. World Health Organization. WHO guidelines on physical activity and sedentary behaviour. https://apps.who.int/iris/bitstream/handle/10665/337001/9789240014886-eng.pdf. Published November 25, 2020. Accessed 15 Aug 2023.

138. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatr. 2017;17(1):230.

139. World Health Organization. A healthy lifestyle - WHO recommendations. https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations. Accessed 25 Aug 2023.
140. Nikl A, Janssen MF, Brodszky V, Rencz F. A head-to-head comparison of the EQ-5D-5L and 15D descriptive systems and index values in a general population sample. Health Qual Life Outcomes. 2023;21(1):17.
141. Nikl A, Janssen MF, Brodszky V, Rencz F. Hungarian population norms for the 15D generic preference-accompanied health status measure. Qual Life Res. 2024;33(1):87-99.
142. Saarni SI, Härkänen T, Sintonen H, Suvisaari J, Koskinen S, Aromaa A, et al. The impact of 29 chronic conditions on health-related quality of life: a general population survey in Finland using 15D and EQ-5D. Qual Life Res. 2006;15(8):1403-14.
143. Geraerds A, Bonsel GJ, Janssen MF, Finch AP, Polinder S, Haagsma JA. Methods Used to Identify, Test, and Assess Impact on Preferences of Bolt-Ons: A Systematic Review. Value Health. 2021;24(6):901-16.
144. Krabbe PF, Stouthard ME, Essink-Bot ML, Bonsel GJ. The effect of adding a cognitive dimension to the EuroQol multiattribute health-status classification system. J Clin Epidemiol. 1999;52(4):293-301.
145. Finch AP, Brazier JE, Mukuria C, Bjorner JB. An Exploratory Study on Using Principal-Component Analysis and Confirmatory Factor Analysis to Identify Bolt-On Dimensions: The EQ-5D Case Study. Value Health. 2017;20(10):1362-75.
146. Finch AP, Brazier JE, Mukuria C. Selecting Bolt-On Dimensions for the EQ-5D: Examining Their Contribution to Health-Related Quality of Life. Value Health. 2019;22(1):50-61.
147. Mulhern BJ, Sampson C, Haywood P, Addo R, Page K, Mott D, et al. Criteria for developing, assessing and selecting candidate EQ-5D bolt-ons. Qual Life Res. 2022;31(10):3041-8.
148. Spronk I, Polinder S, Bonsel GJ, Janssen MF, Haagsma JA. Adding a fatigue item to the EQ-5D-5L improves its psychometric performance in the general population. J Patient Rep Outcomes. 2022;6(1):1.

149. Perneger TV, Combescure C, Courvoisier DS. General population reference values for the French version of the EuroQol EQ-5D health utility instrument. Value Health. 2010;13(5):631-5.
150. Kim SH, Jo MW, Ock M, Lee SI. Exploratory Study of Dimensions of Health-related Quality of Life in the General Population of South Korea. J Prev Med Public Health. 2017;50(6):361-8.
151. Lim C, Shafie A, Thakumar A. Exploration of EQ-5D-5L Bolt-On Items among Malaysian Population. Malaysian Journal of Pharmacy (MJP). 2017;3(1):8-17.
152. Tsuchiya A, Bansback N, Hole AR, Mulhern B. Manipulating the 5 Dimensions of the EuroQol Instrument: The Effects on Self-Reporting Actual Health and Valuing Hypothetical Health States. Med Decis Making. 2019;39(4):379-92.
153. McDonald R, Mullett TL, Tsuchiya A. Understanding the composite dimensions of the EQ-5D: An experimental approach. Soc Sci Med. 2020;265:113323.
154. Eurostat. Physical and sensory functional limitations by sex, age and degree of urbanisation. https://ec.europa.eu/eurostat/databrowser/bookmark/8a1eef5f-9937-4e44-8e23-ae26c2d0eddf?lang=en&page=time:2019. Accessed March 20, 2023.
155. Eurostat. Self-perceived long-standing limitations in usual activities due to health problem by sex, age and labour status. https://ec.europa.eu/eurostat/databrowser/bookmark/419d94e3-667e-455d-8f35-569673031d7b?lang=en. Accessed March 20, 2023.
156. Liegl G, Petersen MA, Groenvold M, Aaronson NK, Costantini A, Fayers PM, et al. Establishing the European Norm for the health-related quality of life domains of the computer-adaptive test EORTC CAT Core. Eur J Cancer. 2019;107:133-41.
157. Prevolnik Rupel V, Ogorevc M. EQ-5D-5L Slovenian population norms. Health Qual Life Outcomes. 2020;18(1):333.
158. Yang Z, Busschbach J, Liu G, Luo N. EQ-5D-5L norms for the urban Chinese population in China. Health Qual Life Outcomes. 2018;16(1):210.
159. Pan T, Mulhern B, Viney R, Norman R, Hanmer J, Devlin N. A Comparison of PROPr and EQ-5D-5L Value Sets. Pharmacoeconomics. 2022;40(3):297-307.
160. Devlin N, Roudijk B, Ludwig K. Value Sets for EQ-5D-5L: Springer Cham; 2022.

161. Klapproth CP, Fischer F, Merbach M, Rose M, Obbarius A. Psychometric properties of the PROMIS Preference score (PROPr) in patients with rheumatological and psychosomatic conditions. BMC Rheumatol. 2022;6(1):15.
162. Brazier JE, Mulhern BJ, Bjorner JB, Gandek B, Rowen D, Alonso J, et al. Developing a New Version of the SF-6D Health State Classification System From the SF-36v2: SF-6Dv2. Med Care. 2020;58(6):557-65.
163. Mulhern BJ, Bansback N, Norman R, Brazier J. Valuing the SF-6Dv2 Classification System in the United Kingdom Using a Discrete-choice Experiment With Duration. Med Care. 2020;58(6):566-73.
164. Sayah FA, Qiu W, Xie F, Johnson JA. Comparative performance of the EQ-5D-5L and SF-6D index scores in adults with type 2 diabetes. Qual Life Res. 2017;26(8):2057-66.
165. Bhadhuri A, Jowett S, Jolly K, Al-Janabi H. A Comparison of the Validity and Responsiveness of the EQ-5D-5L and SF-6D for Measuring Health Spillovers: A Study of the Family Impact of Meningitis. Med Decis Making. 2017;37(8):882-93.
166. Yang F, Lau T, Lee E, Vathsala A, Chia KS, Luo N. Comparison of the preference-based EQ-5D-5L and SF-6D in patients with end-stage renal disease (ESRD). Eur J Health Econ. 2015;16(9):1019-26.
167. Li N, Boonen A, van den Bergh JP, van Kuijk SMJ, Wyers CE, van Oostwaard M, et al. A head-to-head comparison of EQ-5D-5L and SF-6D in Dutch patients with fractures visiting a Fracture Liaison Service. J Med Econ. 2022;25(1):829-39.
168. Qian X, Tan RL, Chuang LH, Luo N. Measurement Properties of Commonly Used Generic Preference-Based Measures in East and South-East Asia: A Systematic Review. Pharmacoeconomics. 2020;38(2):159-70.
169. Lamu AN, Björkman L, Hamre HJ, Alræk T, Musial F, Robberstad B. Validity and responsiveness of EQ-5D-5L and SF-6D in patients with health complaints attributed to their amalgam fillings: a prospective cohort study of patients undergoing amalgam removal. Health Qual Life Outcomes. 2021;19(1):125.
170. Xu RH, Dong D, Luo N, Wong EL, Wu Y, Yu S, et al. Evaluating the psychometric properties of the EQ-5D-5L and SF-6D among patients with haemophilia. Eur J Health Econ. 2021;22(4):547-57.

171. Bethlehem J. Selection bias in web surveys. International statistical review. 2010;78(2):161-88.
172. Kelfve S, Kivi M, Johansson B, Lindwall M. Going web or staying paper? The use of web-surveys among older people. BMC Med Res Methodol. 2020;20(1):252.
173. Eurostat. Individuals - internet use. https://ec.europa.eu/eurostat/databrowser/bookmark/2983627a-a0f1-40a6-af69-cdba9ccd6dfa?lang=en. Accessed 4 Aug 2023.
174. Barry MJ, Walker-Corkery E, Chang Y, Tyll LT, Cherkin DC, Fowler FJ. Measurement of overall and disease-specific health status: does the order of questionnaires make a difference? J Health Serv Res Policy. 1996;1(1):20-7.
175. Cheung YB, Wong LC, Tay MH, Toh CK, Koo WH, Epstein R, et al. Order effects in the assessment of quality of life in cancer patients. Qual Life Res. 2004;13(7):1217-23.
176. Childs AL. Effect of order of administration of health-related quality of life interview instruments on responses. Qual Life Res. 2005;14(2):493-500.
177. Long D, Haagsma JA, Janssen MF, Yfantopoulos JN, Lubetkin EI, Bonsel GJ. Health-related quality of life and mental well-being of healthy and diseased persons in 8 countries: Does stringency of government response against early COVID-19 matter? SSM Popul Health. 2021;15:100913.
178. World Health Organization. Hungary: WHO Coronavirus Disease (COVID-19) Dashboard With Vaccination Data. https://covid19.who.int/region/euro/country/hu. Accessed June 3, 2023.
179. 365/2021. (VI. 30.) Korm. rendelet a védelmi intézkedések lépcsőzetes feloldásának hatodik fokozatára tekintettel a veszélyhelyzet idején alkalmazandó védelmi intézkedéseket szabályozó kormányrendeletek módosításáról. Magyar Közlöny (2021 June 30) https://magyarkozlony.hu/dokumentumok/6d408ec9c88221276266e0b2ed05caea8e79df7a/megtekintes. Accessed June 3, 2023.
180. Rencz F, Tamási B, Brodszky V, Ruzsa G, Gulácsi L, Péntek M. Did You Get What You Wanted? Patient Satisfaction and Congruence Between Preferred and Perceived Roles in Medical Decision Making in a Hungarian National Survey. Value Health Reg Issues. 2020;22:61-7.

181. Coast J, Peters TJ, Natarajan L, Sproston K, Flynn T. An assessment of the construct validity of the descriptive system for the ICECAP capability measure for older people. Qual Life Res. 2008;17(7):967-76.
182. Ratcliffe J, Cameron I, Lancsar E, Walker R, Milte R, Hutchinson CL, et al. Developing a new quality of life instrument with older people for economic evaluation in aged care: study protocol. BMJ Open. 2019;9(5):e028647.

9 Bibliography of candidate's publications

9.1 Publications related to this dissertation

International peer-reviewed journals **Total IF: 10.9**

- **Nikl A,** Janssen MF, Brodszky V, Rencz F. A head-to-head comparison of the EQ-5D-5L and 15D descriptive systems and index values in a general population sample. Health Qual Life Outcomes. 2023;21(1):17. **IF: 3.2 (Q1)**
- **Nikl A,** Janssen MF, Brodszky V, Rencz F. Hungarian population norms for the 15D generic preference-accompanied health status measure. Qual Life Res. 2024;33(1):87-99. **IF: 3.3 (Q1)**
- **Nikl A,** Janssen MF, Jenei B, Brodszky V, Rencz F. Population Norms for the EQ-5D-5L, PROPr and SF-6D in Hungary. Pharmacoeconomics. 2024;42(5):583-603. **IF: 4.4 (D1)**

Conference abstracts

- **Nikl A,** Janssen MF, Brodszky V, Rencz F. MSR70 A Head-to-Head Comparison of the EQ-5D-5L and 15D Descriptive Systems and Index Scores in a General Population Sample. Value Health. 2022;25(12):S363.
- **Nikl A,** Janssen MF, Brodszky V, Rencz F. PCR219 Hungarian Population Norms for the 15D Generic Preference-Accompanied Health Status Measure. Value Health. 2023;26(12):S491.

9.2 Publications not related to this dissertation

Conference abstracts

- **Nikl A,** Brodszky V, Rencz F. PCR139 The Measurement Performance of the EQ-5D-Y-3L and EQ-5D-3L in a Hungarian General Population Sample of Adults. Value Health. 2024;27(12):S533.

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11 Appendices

Appendix 1. Characteristics of the study population (140)

Variables	Total sample (N=1887)		Physical conditions (N=1195) [a]		Mental conditions (N=664) [a]		Hungarian general population (%) [b]	Proportional difference to the total sample (pp)
	n	%	n	%	n	%		
Gender								
Male	800	42.4	486	40.7	271	40.8	46.9	-4.5
Female	1087	57.6	709	59.3	393	59.2	53.1	4.5
Age groups, years								
18-24	191	10.1	67	5.6	59	8.9	10.0	0.1
25-34	413	21.9	196	16.4	140	21.1	15.2	6.7
35-44	309	16.4	163	13.6	106	16.0	19.5	-3.1
45-54	266	14.1	184	15.4	97	14.6	16.0	-1.9
55-64	318	16.9	249	20.8	123	18.5	16.8	0.1
65 and above	390	20.7	336	28.1	139	20.9	22.5	-1.8
Settlement type								
Capital	367	19.4	223	18.7	110	16.6	17.9	1.5
City	923	48.9	557	48.3	313	47.1	52.6	-3.7
Village	597	31.6	395	33.1	241	36.3	29.5	2.1
Geographical region [c]								
Central Hungary	582	30.8	366	30.6	202	30.4	30.7	0.1
Transdanubia	559	29.6	364	30.5	201	30.3	30.1	-0.5
Great Plain and North	746	39.5	465	38.9	261	39.3	39.2	0.3
Highest level of education								
Primary	508	26.9	323	27.0	218	32.8	23.8	3.1
Secondary	846	44.8	518	43.3	305	45.9	55.0	-10.2
Tertiary	533	28.2	354	29.6	141	21.2	21.2	7
Marital status								
Single	444	23.5	228	19.1	150	22.6	18.5	5
Married	789	41.8	541	45.3	247	37.2	45.6	-3.8
Divorced	142	7.5	114	9.5	69	10.4	11.1	-3.6
Widowed	122	6.5	98	8.2	46	6.9	11.4	-4.9
Domestic partnership	390	20.7	214	17.9	152	22.9	13.4	7.3
Occupational status								
Employed	1000	53.0	565	47.3	340	51.2	53.1	-0.1
Unemployed	89	4.7	45	3.8	38	5.7	3.1	1.6
Retired	489	25.9	405	33.9	171	25.8	26.1	-0.2
Disability pensioner	52	2.8	48	4.0	28	4.2	3.1	-0.3
Student	64	3.4	22	1.8	12	1.8	4.7	-1.3
Stay-at-home husband/wife	48	2.5	30	2.5	29	4.4	1.0	1.5
Other	145	7.7	80	6.7	46	6.9	8.9	-1.2
Diagnosed chronic disease [d]								
Mental	155	8.2	-	-	155	23.3	N/A	-
Physical	686	36.4	686	57.4	-	-	48.0	-15.4
Both	509	27.0	509	42.6	509	76.7		
None	383	20.3	-	-	-	-	52.0	31.7
Does not know/answer	154	8.2	-	-	-	-	N/A	-

N/A indicates data not available. pp: percentage points.
Percentages may not total 100 by groups due to rounding.
a – There are overlaps between the physical and mental conditions subgroups as n=509 respondents reported to have both physical and mental conditions.
b – Hungarian Central Statistical Office: Microcensus 2016.
c – Figure represents the population aged 15 or over for the general population.
d – Hungarian Central Statistical Office: European Health Interview Survey in Hungary, 2019.

Appendix 2. Cross-tabulation of EQ-5D-5L and 15D responses between the corresponding dimensions (140)

EQ-5D-5L	15D					Inconsistent response pairs, n (%)	Average size of inconsistencies
Dimensions	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**		
Mobility, n (%)							
Level 1	1163 (93.3)	49 (3.9)	27 (2.2)	1 (0.1)	6 (0.5)	149 (7.90)	1.20
Level 2	223 (64.1)	108 (31.0)	14 (4.0)	1 (0.3)	2 (0.6)		
Level 3	71 (35.9)	98 (49.5)	20 (10.1)	6 (3.0)	3 (1.5)		
Level 4	15 (17.0)	22 (25.0)	48 (54.5)	3 (3.4)	0 (0.0)		
Level 5	0 (0.0)	0 (0.0)	1 (14.3)	3 (42.9)	3 (42.9)		
Usual activities, n (%)							
Level 1	1290 (92.6)	73 (5.2)	23 (1.7)	5 (0.4)	2 (0.1)	88 (4.66)	1.24
Level 2	136 (45.2)	138 (45.8)	23 (7.6)	4 (1.3)	0 (0.0)		
Level 3	29 (22.1)	63 (48.1)	29 (22.1)	9 (6.9)	1 (0.8)		
Level 4	12 (20.7)	12 (20.7)	16 (27.6)	15 (25.9)	3 (5.2)		
Level 5	0 (0.0)	0 (0.0)	0 (0.0)	2 (50.0)	2 (50.0)		
Pain/discomfort (EQ-5D-5L) *and* Discomfort and symptoms (15D), n (%)							
Level 1	884 (92.2)	59 (6.2)	9 (0.9)	5 (0.5)	2 (0.2)	122 (6.47)	1.16
Level 2	322 (54.7)	231 (39.2)	32 (5.4)	2 (0.3)	2 (0.3)		
Level 3	72 (27.2)	112 (42.3)	67 (25.3)	12 (4.5)	2 (0.8)		
Level 4	9 (13.8)	18 (27.7)	18 (27.7)	18 (27.7)	2 (3.1)		
Level 5	0 (0.0)	0 (0.0)	1 (11.1)	7 (77.8)	1 (11.1)		
Anxiety/depression (EQ-5D-5L) *and* Depression (15D), n (%)							
Level 1	1063 (92.7)	59 (5.1)	17 (1.5)	4 (0.3)	4 (0.3)	87 (4.61)	1.24
Level 2	196 (43.6)	221 (49.1)	27 (6.0)	5 (1.1)	1 (0.2)		
Level 3	30 (14.5)	82 (39.6)	76 (36.7)	15 (7.2)	4 (1.9)		
Level 4	5 (8.3)	10 (16.7)	23 (38.3)	18 (30.0)	4 (6.7)		
Level 5	1 (4.3)	1 (4.3)	5 (21.7)	8 (34.8)	8 (34.8)		
Anxiety/depression (EQ-5D-5L) *and* Distress (15D), n (%)							
Level 1	911 (79.4)	201 (17.5)	24 (2.1)	9 (0.8)	2 (0.2)	102 (5.41)	1.24
Level 2	110 (24.4)	273 (60.7)	51 (11.3)	13 (2.9)	3 (0.7)		
Level 3	26 (12.6)	71 (34.3)	69 (33.3)	35 (16.9)	6 (2.9)		
Level 4	7 (11.7)	9 (15.0)	19 (31.7)	14 (23.3)	11 (18.3)		
Level 5	0 (0.0)	1 (4.3)	2 (8.7)	9 (39.1)	11 (47.8)		

Percentages may not total 100 by rows due to rounding.

Appendix 3. Distribution of EQ-5D-5L and 15D results within each domain (N=1887) (140)

EQ-5D-5L						15D					
Dimensions	**Levels**					**Dimensions**	**Levels**				
	1	**2**	**3**	**4**	**5**		**1**	**2**	**3**	**4**	**5**
Mobility (walking)	1246 (66.0)	348 (18.4)	198 (10.5)	88 (4.7)	7 (0.4)	Mobility (walking, moving about)	1472 (78.0)	277 (14.7)	110 (5.8)	14 (0.7)	14 (0.7)
Self-care (washing or dressing)	1654 (87.7)	127 (6.7)	68 (3.6)	29 (1.5)	9 (0.5)	-	-	-	-	-	-
Usual activities (e.g. work, study, housework, family or leisure activities)	1393 (73.8)	301 (16.0)	131 (6.9)	58 (3.1)	4 (0.2)	Usual activities (e.g. employment, studying, housework, free-time activities)	1467 (77.7)	286 (15.2)	91 (4.8)	35 (1.9)	8 (0.4)
Pain/discomfort	959 (50.8)	589 (31.2)	265 (14.0)	65 (3.4)	9 (0.5)	Discomfort and symptoms (e.g. pain, ache, nausea, itching etc.)	1287 (68.2)	420 (22.3)	127 (6.7)	44 (2.3)	9 (0.5)
Anxiety/depression	1147 (60.8)	450 (23.8)	207 (11.0)	60 (3.2)	23 (1.2)	Depression (sad, melancholic or depressed)	1295 (68.6)	373 (19.8)	148 (7.8)	50 (2.6)	21 (1.1)
						Distress (anxious, stressed or nervous)	1054 (55.9)	555 (29.4)	165 (8.7)	80 (4.2)	33 (1.7)
-	-	-	-	-	-	Vision (seeing and reading with or without glasses)	1360 (72.1)	355 (18.8)	125 (6.6)	30 (1.6)	17 (0.9)
						Hearing (with or without a hearing aid)	1581 (83.8)	200 (10.6)	83 (4.4)	17 (0.9)	6 (0.3)
						Breathing (breathing difficulties, shortness of breath)	1342 (71.1)	400 (21.2)	95 (5.0)	29 (1.5)	21 (1.1)
						Sleeping	921 (48.8)	644 (34.1)	246 (13.0)	62 (3.3)	14 (0.7)
						Eating	1781 (94.4)	54 (2.9)	37 (2.0)	12 (0.6)	3 (0.2)
						Speech	1701 (90.1)	124 (6.6)	44 (2.3)	13 (0.7)	5 (0.3)
						Excretion (bladder and bowel)	1399 (74.1)	382 (20.2)	75 (4.0)	17 (0.9)	14 (0.7)
						Mental function (thinking clearly and logically, memory)	1596 (84.6)	218 (11.6)	48 (2.5)	18 (1.0)	7 (0.4)
						Vitality (e.g., healthy and energetic, weary, tired or feeble, exhausted)	950 (50.3)	624 (33.1)	203 (10.8)	90 (4.8)	20 (1.1)
						Sexual activities	1313 (69.6)	300 (15.9)	155 (8.2)	46 (2.4)	73 (3.9)

Percentages may not total 100 by rows due to rounding.

Appendix 4. Distribution of EQ-5D-5L and 15D results within each domain among respondents with physical conditions (N=1195) (140)

EQ-5D-5L						15D					
Dimensions	**Levels**					**Dimensions**	**Levels**				
	1	**2**	**3**	**4**	**5**		**1**	**2**	**3**	**4**	**5**
Mobility (walking)	670 (56.1)	279 (23.2)	163 (13.6)	78 (6.5)	5 (0.4)	Mobility (walking, moving about)	877 (73.4)	224 (18.7)	80 (6.7)	8 (0.7)	6 (0.5)
Self-care (washing or dressing)	1027 (85.9)	91 (7.6)	47 (3.9)	22 (1.8)	8 (0.7)	-	-	-	-	-	-
Usual activities (e.g. work, study, housework, family or leisure activities)	798 (66.8)	234 (19.6)	112 (9.4)	49 (4.1)	2 (0.2)	Usual activities (e.g. employment, studying, housework, free-time activities)	857 (71.7)	248 (20.8)	61 (5.1)	28 (2.3)	1 (0.1)
Pain/discomfort	474 (39.7)	436 (36.5)	223 (18.7)	55 (4.6)	7 (0.6)	Discomfort and symptoms (e.g. pain, ache, nausea, itching etc.)	719 (60.2)	344 (28.8)	93 (7.8)	37 (3.1)	2 (0.2)
Anxiety/depression	675 (56.5)	309 (25.9)	149 (12.5)	46 (3.8)	16 (1.3)	Depression (sad, melancholic or depressed)	777 (65.0)	273 (22.8)	99 (8.3)	34 (2.8)	12 (1.0)
						Distress (anxious, stressed or nervous)	607 (50.8)	397 (33.2)	114 (9.5)	58 (4.9)	19 (1.6)
-	-	-	-	-	-	Vision (seeing and reading with or without glasses)	812 (67.9)	266 (22.3)	89 (7.4)	23 (1.9)	5 (0.4)
						Hearing (with or without a hearing aid)	966 (80.8)	170 (14.2)	45 (3.8)	12 (1.0)	2 (0.2)
						Breathing (breathing difficulties, shortness of breath)	765 (60.4)	330 (27.6)	55 (4.6)	28 (2.3)	17 (1.4)
						Sleeping	491 (41.1)	462 (38.7)	178 (14.9)	55 (4.6)	9 (0.8)
						Eating	1150 (96.2)	31 (2.6)	11 (0.9)	3 (0.3)	0 (0.0)
						Speech	1084 (90.7)	86 (7.2)	15 (1.3)	8 (0.7)	2 (0.2)
						Excretion (bladder and bowel)	814 (68.1)	314 (26.3)	51 (4.3)	9 (0.8)	7 (0.6)
						Mental function (thinking clearly and logically, memory)	989 (82.8)	172 (14.4)	27 (2.3)	6 (0.5)	1 (0.1)
						Vitality (e.g., healthy and energetic, weary, tired or feeble, exhausted)	502 (42.0)	458 (38.3)	162 (13.6)	63 (5.3)	10 (0.8)
						Sexual activities	735 (61.5)	240 (20.1)	120 (10.0)	34 (2.8)	66 (5.5)

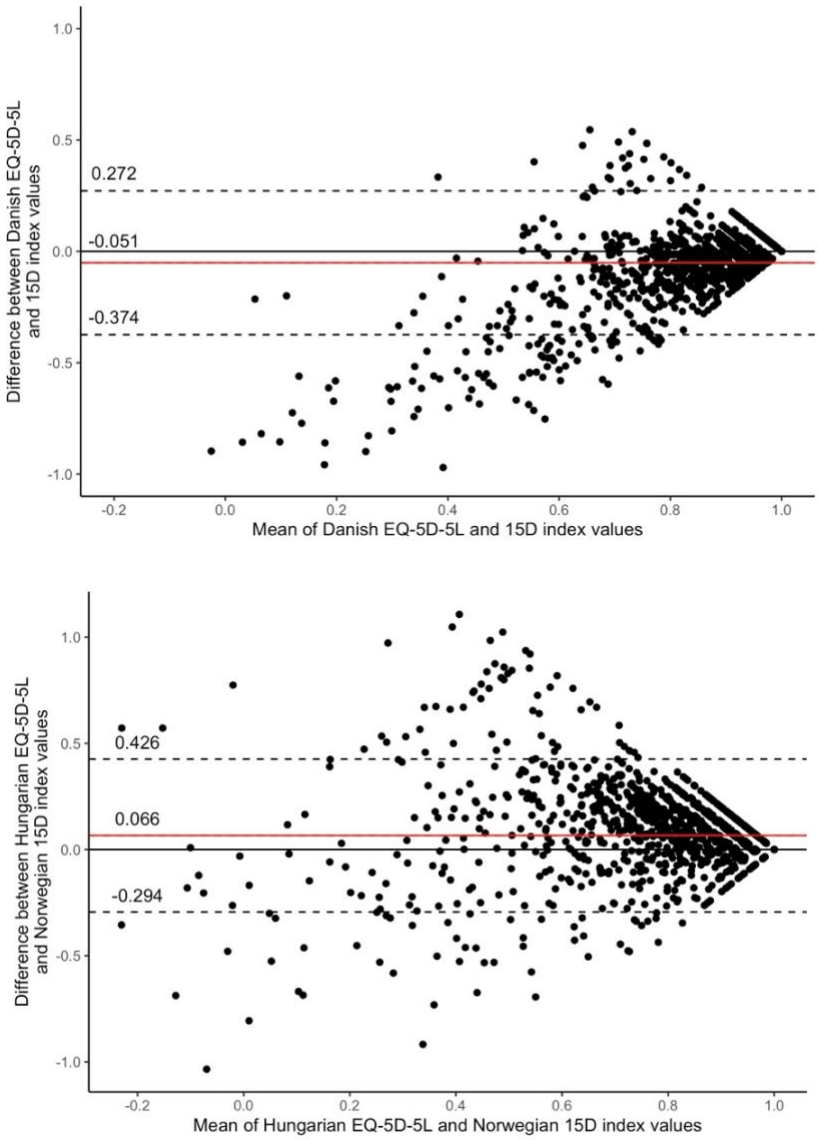
Percentages may not total 100 by rows due to rounding.

Appendix 5. Distribution of EQ-5D-5L and 15D results within each domain among respondents with mental conditions (N=664) (140)

EQ-5D-5L						15D					
Dimensions	**Levels**					**Dimensions**	**Levels**				
	1	**2**	**3**	**4**	**5**		**1**	**2**	**3**	**4**	**5**
Mobility (walking)	359 (54.1)	152 (22.9)	107 (16.1)	43 (6.5)	3 (0.5)	Mobility (walking, moving about)	467 (70.3)	137 (20.6)	51 (7.7)	7 (1.1)	2 (0.3)
Self-care (washing or dressing)	538 (81.0)	72 (10.8)	34 (5.1)	16 (2.4)	4 (0.6)	-	-	-	-	-	-
Usual activities (e.g. work, study, housework, family or leisure activities)	415 (62.5)	142 (21.4)	72 (10.8)	33 (5.0)	2 (0.3)	Usual activities (e.g. employment, studying, housework, free-time activities)	436 (65.7)	148 (22.3)	52 (7.8)	27 (4.1)	1 (0.2)
Pain/discomfort	226 (34.0)	242 (36.4)	145 (21.8)	43 (6.5)	8 (1.2)	Discomfort and symptoms (e.g. pain, ache, nausea, itching etc.)	355 (53.5)	201 (30.3)	70 (10.5)	34 (5.1)	4 (0.6)
Anxiety/depression	272 (41.0)	205 (30.9)	134 (20.2)	37 (5.6)	16 (2.4)	Depression (sad, melancholic or depressed)	343 (51.7)	191 (28.8)	85 (12.8)	35 (5.3)	10 (1.5)
						Distress (anxious, stressed or nervous)	262 (39.5)	229 (34.5)	101 (15.2)	54 (8.1)	18 (2.7)
-	-	-	-	-	-	Vision (seeing and reading with or without glasses)	408 (61.4)	169 (25.5)	63 (9.5)	18 (2.7)	6 (0.9)
						Hearing (with or without a hearing aid)	512 (77.1)	100 (15.1)	41 (6.2)	10 (1.5)	1 (0.2)
						Breathing (breathing difficulties, shortness of breath)	379 (57.1)	201 (30.3)	50 (7.5)	21 (3.2)	13 (2.0)
						Sleeping	225 (33.9)	234 (35.2)	142 (21.4)	54 (8.1)	9 (1.4)
						Eating	608 (91.6)	30 (4.5)	19 (2.9)	7 (1.1)	0 (0.0)
						Speech	564 (84.9)	69 (10.4)	19 (2.9)	10 (1.5)	2 (0.3)
						Excretion (bladder and bowel)	427 (64.3)	170 (25.6)	50 (7.5)	11 (1.7)	6 (0.9)
						Mental function (thinking clearly and logically, memory)	504 (75.9)	123 (18.5)	25 (3.8)	10 (1.5)	2 (0.3)
						Vitality (e.g., healthy and energetic, weary, tired or feeble, exhausted)	240 (36.1)	241 (36.3)	115 (17.3)	56 (8.4)	12 (1.8)
						Sexual activities	373 (56.2)	130 (19.6)	89 (13.4)	26 (3.9)	46 (6.9)

Percentages may not total 100 by rows due to rounding.

Appendix 6. Bland-Altman plot of EQ-5D-5L and 15D index values (140)



The horizontal red line represents the mean of the differences (D) between EQ-5D-5L and 15D index values, while the 95% confidence interval is represented by the dashed lines, which was obtained as D ± 1.96*SD (SD: standard deviation of the differences).

Appendix 7. Known-groups validity of the EQ-5D-5L (Hungarian value set) and 15D (Norwegian value set) (140)

	n (%)	EQ-5D-5L				15D				RE [b]	95% CI [c]
		Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES	Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES		
Healthy	383 (20.3)	0.95 (0.10)	1.0 (0.96-1.00)	-	-	0.90 (0.20)	0.97 (0.89-1.00)	-	-	-	-
Physical conditions											
Hypertension	527 (27.9)	0.80 (0.27)	0.89 (0.76-0.97)	<0.001	1.233	0.75 (0.22)	0.80 (0.63-0.93)	<0.001	1.064	1.031	0.863-1.295
Musculoskeletal diseases	461 (24.4)	0.75 (0.28)	0.84 (0.71-0.92)	<0.001	1.366	0.71 (0.22)	0.76 (0.59-0.89)	<0.001	1.190	1.054	0.900-1.280
Allergies	318 (16.9)	0.84 (0.22)	0.92 (0.80-1.00)	<0.001	1.596	0.76 (0.22)	0.82 (0.65-0.93)	<0.001	1.410	1.022	0.818-1.354
Cardiovascular disease	259 (13.7)	0.72 (0.30)	0.83 (0.63-0.92)	<0.001	2.592	0.65 (0.22)	0.68 (0.48-0.84)	<0.001	2.303	1.002	0.855-1.195
Gastrointestinal or hepatic disease	241 (12.8)	0.77 (0.28)	0.88 (0.71-0.96)	<0.001	2.685	0.69 (0.22)	0.75 (0.57-0.89)	<0.001	2.386	1.013	0.848-1.252
Hyperlipidaemia	240 (12.7)	0.79 (0.28)	0.88 (0.76-0.96)	<0.001	1.655	0.71 (0.22)	0.76 (0.58-0.89)	<0.001	1.468	0.977	0.810-1.221
Eye or visual diseases	231 (12.2)	0.76 (0.27)	0.84 (0.70-0.93)	<0.001	2.739	0.64 (0.22)	0.65 (0.49-0.86)	<0.001	2.434	0.902	0.763-1.083
Diabetes	205 (10.9)	0.77 (0.31)	0.88 (0.71-0.97)	<0.001	1.890	0.72 (0.22)	0.77 (0.59-0.93)	<0.001	1.684	1.146	0.938-1.483
Gastroesophageal reflux disease	186 (9.9)	0.77 (0.29)	0.88 (0.71-0.96)	<0.001	1.886	0.71 (0.22)	0.76 (0.57-0.90)	<0.001	1.682	1.128	0.917-1.455
Respiratory diseases	175 (9.3)	0.80 (0.28)	0.89 (0.77-0.96)	<0.001	3.099	0.70 (0.22)	0.75 (0.57-0.89)	<0.001	2.751	0.933	0.753-1.196
Arrhythmias	172 (9.1)	0.74 (0.26)	0.83 (0.66-0.92)	<0.001	1.826	0.64 (0.22)	0.67 (0.47-0.83)	<0.001	1.629	1.066	0.880-1.311
Thyroid diseases	171 (9.1)	0.80 (0.26)	0.89 (0.76-0.96)	<0.001	1.726	0.74 (0.22)	0.79 (0.65-0.91)	<0.001	1.538	1.185	0.954-1.583
Skin diseases	166 (8.8)	0.80 (0.29)	0.92 (0.79-0.96)	<0.001	3.167	0.72 (0.22)	0.78 (0.59-0.92)	<0.001	2.811	1.007	0.815-1.298
Headache, migraine	139 (7.4)	0.75 (0.31)	0.86 (0.70-0.96)	<0.001	3.396	0.67 (0.22)	0.74 (0.52-0.90)	<0.001	3.008	1.090	0.890-1.374
Hearing impairment	133 (7.1)	0.75 (0.30)	0.85 (0.65-0.96)	<0.001	2.332	0.68 (0.22)	0.76 (0.54-0.87)	<0.001	2.086	1.171	0.957-1.487
Benign prostate hyperplasia	88 (4.7)	0.81 (0.24)	0.89 (0.80-0.96)	<0.001	2.276	0.71 (0.22)	0.76 (0.59-0.89)	<0.001	2.040	1.120	0.832-1.515
Urinary incontinence	71 (3.8)	0.67 (0.34)	0.80 (0.53-0.93)	<0.001	2.676	0.62 (0.22)	0.68 (0.42-0.80)	<0.001	2.396	1.302	1.049-1.651
Cancer, leukemia, lymphoma	46 (2.4)	0.75 (0.30)	0.88 (0.62-0.96)	<0.001	2.473	0.66 (0.22)	0.72 (0.48-0.86)	<0.001	2.219	1.300	0.958-1.835
Chronic kidney disease	29 (1.5)	0.73 (0.30)	0.83 (0.58-0.92)	<0.001	2.690	0.64 (0.22)	0.68 (0.52-0.82)	<0.001	2.412	1.456	1.028-2.074
Epilepsy	17 (0.9)	0.69 (0.35)	0.83 (0.59-0.96)	0.006	3.069	0.58 (0.22)	0.57 (0.38-0.85)	0.006	2.745	1.428	0.891-2.240
Liver cirrhosis	14 (0.7)	0.68 (0.38)	0.79 (0.56-0.99)	0.018	2.460	0.56 (0.22)	0.54 (0.36-0.89)	0.018	2.210	1.407	0.996-1.903
Other physical health conditions	92 (4.9)	0.76 (0.27)	0.85 (0.65-0.96)	<0.001	3.029	0.72 (0.22)	0.77 (0.58-0.86)	<0.001	2.701	1.454	1.105-1.962

	n (%)	EQ-5D-5L				15D				RE [b]	95% CI [c]
		Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES	Mean (SD)	Median (Q1-Q3)	p-value [a]	Cohen's d ES		
Mental conditions											
Smoking addiction	381 (20.2)	0.83 (0.25)	0.92 (0.80-0.97)	<0.001	1.563	0.75 (0.22)	0.82 (0.65-0.93)	<0.001	1.376	1.003	0.824-1.297
Anxiety, phobia, or panic disorder	172 (9.1)	0.71 (0.29)	0.80 (0.61-0.92)	<0.001	3.121	0.57 (0.22)	0.62 (0.37-0.79)	<0.001	2.771	0.934	0.790-1.128
Sleeping disorders	169 (9.0)	0.70 (0.30)	0.80 (0.62-0.91)	<0.001	1.809	0.61 (0.22)	0.66 (0.42-0.82)	<0.001	1.613	1.068	0.887-1.302
Other addictions [d]	98 (5.2)	0.79 (0.26)	0.88 (0.77-0.96)	<0.001	4.360	0.68 (0.22)	0.76 (0.56-0.92)	<0.001	3.816	1.156	0.847-1.584
Depression or dysthymia	79 (4.2)	0.62 (0.32)	0.70 (0.50-0.85)	<0.001	4.089	0.50 (0.22)	0.55 (0.33-0.67)	<0.001	3.594	1.072	0.861-1.334
Alcohol addiction	73 (3.9)	0.79 (0.26)	0.89 (0.69-0.96)	<0.001	2.526	0.63 (0.22)	0.72 (0.47-0.84)	<0.001	2.264	0.988	0.723-1.322
Substance addiction	55 (2.9)	0.70 (0.36)	0.88 (0.57-0.96)	0.002	3.027	0.58 (0.22)	0.72 (0.26-0.93)	0.002	2.708	1.354	0.833-2.134
Sexual disorder	40 (2.1)	0.74 (0.29)	0.83 (0.65-0.96)	<0.001	1.649	0.57 (0.22)	0.63 (0.42-0.73)	<0.001	1.475	1.017	0.738-1.330
Bipolar depression	35 (1.9)	0.67 (0.30)	0.76 (0.53-0.87)	<0.001	1.722	0.53 (0.22)	0.58 (0.32-0.73)	<0.001	1.542	1.253	0.933-1.647
Personality disorder	31 (1.6)	0.61 (0.30)	0.70 (0.45-0.83)	<0.001	2.096	0.42 (0.22)	0.46 (0.26-0.64)	<0.001	1.883	1.197	0.898-1.596
Learning disability	28 (1.5)	0.76 (0.30)	0.88 (0.64-0.97)	0.002	2.280	0.60 (0.22)	0.73 (0.31-0.93)	0.002	2.048	1.145	0.710-1.696
Eating disorder	26 (1.4)	0.69 (0.35)	0.83 (0.59-0.92)	<0.001	2.288	0.56 (0.22)	0.69 (0.22-0.83)	<0.001	2.055	1.251	0.886-1.702
Obsessive compulsive disorder	21 (1.1)	0.58 (0.35)	0.76 (0.50-0.83)	<0.001	1.822	0.36 (0.22)	0.44 (0.08-0.63)	<0.001	1.634	1.157	0.736-1.703
Dementia	18 (1.0)	0.47 (0.29)	0.50 (0.25-0.62)	<0.001	2.229	0.37 (0.22)	0.33 (0.11-0.58)	<0.001	2.004	1.672	1.222-2.373
Psychotic disorders	17 (0.9)	0.66 (0.38)	0.76 (0.57-0.91)	0.005	2.257	0.37 (0.22)	0.33 (0.06-0.67)	0.005	2.029	0.972	0.507-1.562
Post-traumatic stress disorder	14 (0.7)	0.55 (0.27)	0.58 (0.51-0.73)	<0.001	1.725	0.30 (0.22)	0.34 (0.06-0.48)	<0.001	1.546	1.252	0.845-1.709
Impulse-control disorder	14 (0.7)	0.64 (0.36)	0.71 (0.42-0.95)	0.006	2.220	0.42 (0.22)	0.32 (0.25-0.66)	0.006	1.995	1.142	0.646-1.765
Autism spectrum disorder	11 (0.6)	0.57 (0.33)	0.70 (0.45-0.82)	0.003	2.536	0.31 (0.22)	0.36 (-0.02-0.60)	0.003	2.278	1.216	0.699-1.888
Attention deficit hyperactivity disorder	10 (0.5)	0.55 (0.35)	0.64 (0.34-0.81)	0.005	2.335	0.29 (0.22)	0.24 (0.01-0.57)	0.005	2.099	1.230	0.706-1.816

CI confidence intervals, ES effect size, RE relative efficiency.

[a] Student's t-test compared to the healthy subgroup, where $p < 0.05$ was considered statistically significant.

[b] Relative efficiency compared to 15D.

[c] 2000 bootstrap samples with accelerated bias correction.

[d] Includes gambling or other addictions.

Appendix 8. Cross-tabulation of EQ-5D-5L and 15D responses between the corresponding dimensions among respondents with physical conditions (N=1195) (140)

EQ-5D-5L	15D					Inconsistent response pairs, n (%)	Average size of inconsistencies
Dimensions	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**		
Mobility, n (%)							
Level 1	634 (94.6)	25 (3.7)	8 (1.2)	0 (0.0)	3 (0.4)	95 (7.95)	1.16
Level 2	183 (65.6)	86 (30.8)	9 (3.2)	0 (0.0)	1 (0.4)		
Level 3	52 (31.9)	91 (55.8)	16 (9.8)	4 (2.5)	0 (0.0)		
Level 4	8 (10.3)	22 (28.2)	46 (59.0)	2 (2.6)	0 (0.0)		
Level 5	0 (0.0)	0 (0.0)	1 (20.0)	2 (40.0)	2 (40.0)		
Usual activities, n (%)							
Level 1	730 (91.5)	58 (7.3)	7 (0.9)	3 (0.4)	0 (0.0)	52 (4.35)	1.19
Level 2	97 (41.5)	122 (52.1)	14 (6.0)	1 (0.4)	0 (0.0)		
Level 3	23 (20.5)	57 (50.9)	24 (21.4)	8 (7.1)	0 (0.0)		
Level 4	7 (14.3)	11 (22.4)	16 (32.7)	14 (28.6)	1 (2.0)		
Level 5	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)		
Pain/discomfort (EQ-5D-5L) *and* Discomfort and symptoms (15D), n (%)							
Level 1	432 (91.1)	36 (7.6)	4 (0.8)	2 (0.4)	0 (0.0)	85 (7.11)	1.09
Level 2	227 (52.1)	193 (44.3)	14 (3.2)	2 (0.5)	0 (0.0)		
Level 3	6 (24.2)	15 (44.8)	16 (26.0)	17 (4.5)	1 (0.4)		
Level 4	6 (10.9)	15 (27.3)	16 (29.1)	17 (30.9)	1 (1.8)		
Level 5	0 (0.0)	0 (0.0)	1 (14.3)	6 (85.7)	0 (0.0)		
Anxiety/depression (EQ-5D-5L) *and* Depression (15D), n (%)							
Level 1	626 (92.7)	37 (5.5)	10 (1.5)	1 (0.1)	1 (0.1)	46 (3.85)	1.22
Level 2	130 (42.1)	162 (52.4)	15 (4.9)	2 (0.6)	0 (0.0)		
Level 3	16 (10.7)	66 (44.3)	54 (36.2)	11 (7.4)	2 (1.3)		
Level 4	4 (8.7)	7 (15.2)	19 (41.3)	13 (28.3)	3 (6.5)		
Level 5	1 (6.2)	1 (6.2)	1 (6.2)	7 (43.8)	6 (37.5)		
Anxiety/depression (EQ-5D-5L) *and* Distress (15D), n (%)							
Level 1	525 (77.8)	135 (20.0)	13 (1.9)	2 (0.3)	0 (0.0)	55 (4.60)	1.18
Level 2	64 (20.7)	201 (65.0)	33 (10.7)	9 (2.9)	2 (0.6)		
Level 3	13 (8.7)	54 (36.2)	52 (34.9)	27 (18.1)	3 (2.0)		
Level 4	5 (10.9)	6 (13.0)	15 (32.6)	13 (28.3)	7 (15.2)		
Level 5	0 (0.0)	1 (6.2)	1 (6.2)	7 (43.8)	7 (43.8)		

Percentages may not total 100 by rows due to rounding.

Appendix 9. Cross-tabulation of EQ-5D-5L and 15D responses between the corresponding dimensions among respondents with mental conditions (N=664) (140)

EQ-5D-5L	15D					Inconsistent response pairs, n (%)	Average size of inconsistencies
Dimensions	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**		
Mobility, n (%)							
Level 1	325 (90.5)	25 (7.0)	8 (2.2)	0 (0.0)	1 (0.3)	66 (9.94)	1.09
Level 2	99 (65.1)	45 (29.6)	7 (4.6)	1 (0.7)	0 (0.0)		
Level 3	39 (36.4)	55 (51.4)	9 (8.4)	4 (3.7)	0 (0.0)		
Level 4	4 (9.3)	12 (27.9)	26 (60.5)	1 (2.3)	0 (0.0)		
Level 5	0 (0.0)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)		
Usual activities, n (%)							
Level 1	363 (87.5)	36 (8.7)	12 (2.9)	4 (1.0)	0 (0.0)	40 (6.02)	1.20
Level 2	56 (39.4)	74 (52.1)	10 (7.0)	2 (1.4)	0 (0.0)		
Level 3	13 (18.1)	33 (45.8)	18 (25.0)	8 (11.1)	0 (0.0)		
Level 4	4 (12.1)	5 (15.2)	12 (36.4)	11 (33.3)	1 (3.0)		
Level 5	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)		
Pain/discomfort (EQ-5D-5L) *and* Discomfort and symptoms (15D), n (%)							
Level 1	203 (89.8)	19 (8.4)	4 (1.8)	0 (0.0)	0 (0.0)	56 (8.43)	1.10
Level 2	113 (46.7)	110 (45.5)	16 (6.6)	2 (0.8)	1 (0.4)		
Level 3	35 (24.1)	64 (44.1)	36 (24.8)	9 (6.2)	1 (0.7)		
Level 4	4 (9.3)	8 (18.6)	13 (30.2)	17 (39.5)	1 (2.3)		
Level 5	0 (0.0)	0 (0.0)	1 (12.5)	6 (75.0)	1 (12.5)		
Anxiety/depression (EQ-5D-5L) *and* Depression (15D), n (%)							
Level 1	245 (90.1)	18 (6.6)	6 (2.2)	3 (1.1)	0 (0.0)	40 (6.02)	1.18
Level 2	82 (40.0)	106 (51.7)	12 (5.9)	4 (2.0)	1 (0.5)		
Level 3	14 (10.4)	61 (45.5)	48 (35.8)	10 (7.5)	1 (0.7)		
Level 4	1 (2.7)	6 (16.2)	16 (43.2)	12 (32.4)	2 (5.4)		
Level 5	1 (6.2)	0 (0.0)	3 (18.8)	6 (37.5)	6 (37.5)		
Anxiety/depression (EQ-5D-5L) *and* Distress (15D), n (%)							
Level 1	209 (76.8)	50 (18.4)	8 (2.9)	5 (1.8)	0 (0.0)	49 (7.38)	1.20
Level 2	38 (18.5)	129 (62.9)	26 (12.7)	9 (4.4)	3 (1.5)		
Level 3	14 (10.4)	45 (33.6)	50 (37.3)	23 (17.2)	2 (1.5)		
Level 4	1 (2.7)	4 (10.8)	15 (40.5)	12 (32.4)	5 (13.5)		
Level 5	0 (0.0)	1 (6.2)	2 (12.5)	5 (31.2)	8 (50.0)		

Percentages may not total 100 by rows due to rounding.

Appendix 10. Correlation coefficients between 15D and EQ-5D-5L items among respondents with physical conditions (N=1195) (140)

	EQ-5D-5L					EQ VAS	EQ-5D-5L index value (Danish)	15D index value (Danish)	EQ-5D-5L index value (Hungarian)	15D index value (Norwegian)
	Mobility	**Self-care**	**Usual activities**	**Pain/discomfort**	**Anxiety/depression**					
15D										
Mobility	**0.620**	0.465	0.569	0.426	0.192	-0.425	-0.493	-0.548	-0.543	-0.532
Vision	0.257	0.197	0.259	0.282	0.248	-0.287	-0.321	-0.470	-0.316	-0.474
Hearing	0.204	0.231	0.197	0.190	0.123	-0.214	-0.217	-0.359	-0.227	-0.354
Breathing	0.378	0.264	0.387	0.341	0.265	-0.345	-0.396	-0.609	-0.405	-0.593
Sleeping	0.255	0.188	0.296	0.471	0.454	-0.349	-0.498	-0.628	-0.470	-0.637
Eating	0.091	0.212	0.135	0.111	0.111	-0.129	-0.147	-0.267	-0.142	-0.263
Speech	0.128	0.204	0.175	0.179	0.246	-0.185	-0.235	-0.371	-0.217	-0.366
Excretion	0.241	0.177	0.252	0.327	0.247	-0.273	-0.339	-0.518	-0.331	-0.531
Usual activities	0.508	0.475	**0.653**	0.509	0.355	-0.499	-0.585	-0.664	-0.602	-0.658
Mental function	0.218	0.232	0.262	0.321	0.352	-0.240	-0.366	-0.509	-0.347	-0.499
Discomfort and symptoms	0.405	0.282	0.441	**0.601**	0.472	-0.468	-0.609	-0.724	-0.589	-0.727
Depression	0.188	0.193	0.284	0.416	**0.717**	-0.376	-0.576	-0.679	-0.507	-0.689
Distress	0.192	0.142	0.277	0.421	**0.678**	-0.349	-0.555	-0.651	-0.490	-0.676
Vitality	0.402	0.280	0.476	0.555	0.507	-0.537	-0.627	-0.789	-0.605	-0.792
Sexual activities	0.354	0.246	0.419	0.424	0.319	-0.392	-0.455	-0.632	-0.455	-0.638
EQ VAS	-0.482	-0.362	-0.483	-0.584	-0.397	-	-	-	-	-
EQ-5D-5L index value (Danish)	-0.664	-0.483	-0.680	-0.835	-0.736	0.608	-	-	-	-
15D index value (Danish)	-0.506	-0.380	-0.550	-0.652	-0.591	0.594	0.736	-	-	-
EQ-5D-5L index value (Hungarian)	-0.728	-0.529	-0.727	-0.845	-0.630	0.611	0.962	0.694	-	-
15D index value (Norwegian)	-0.498	-0.369	-0.542	-0.652	-0.601	0.594	0.727	0.998	0.683	-

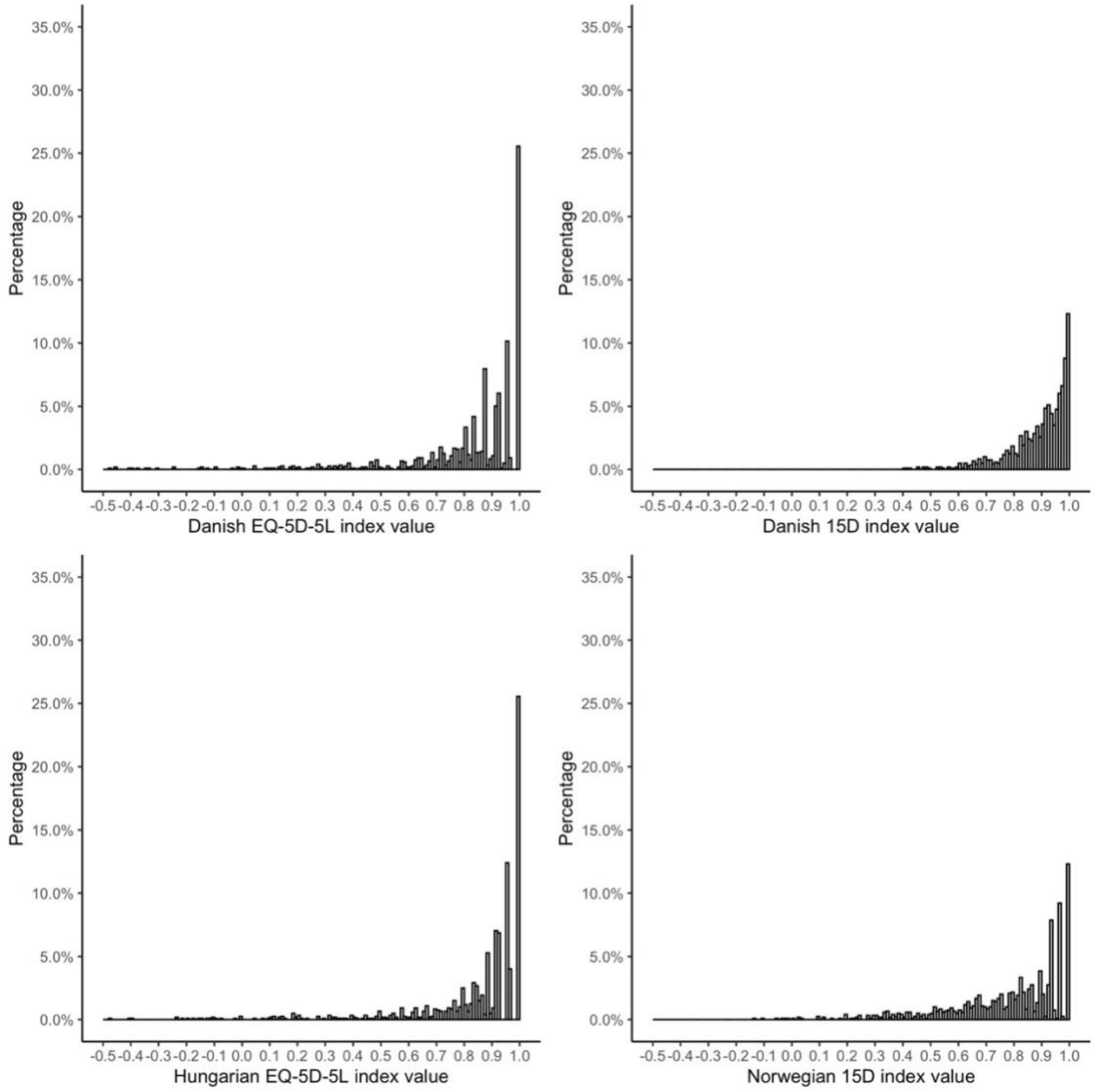
Pearson correlation coefficient was calculated for the continuous index values, while Spearman's rank correlation for the ordinal dimensions.
$p < 0.05$ for all correlation coefficients (two-tailed).
Corresponding dimensions between EQ-5D-5L and 15D are in bold.

Appendix 11. Correlation coefficients between 15D and EQ-5D-5L items among respondents with mental conditions (N=664) (140)

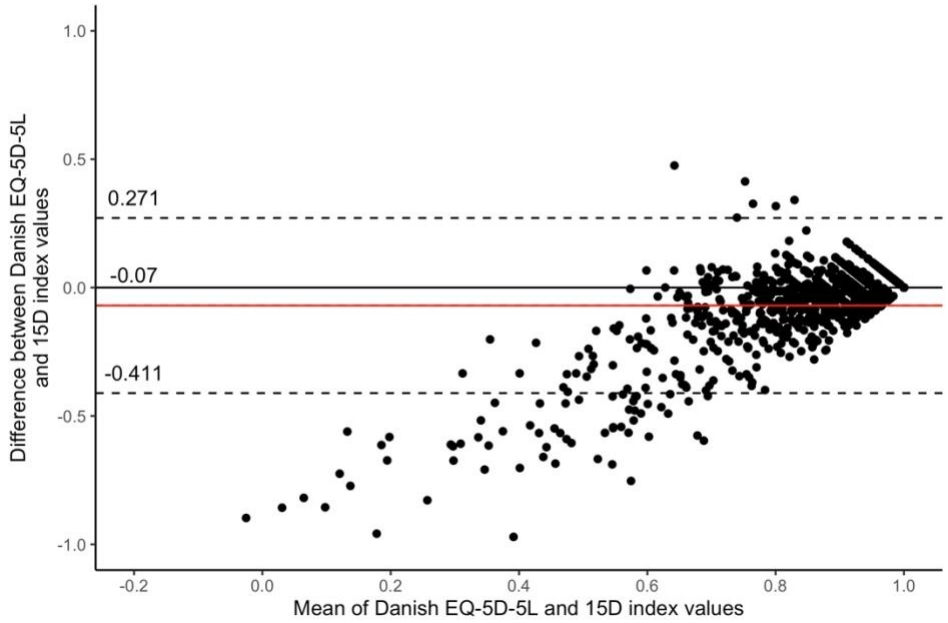
	EQ-5D-5L					EQ VAS	EQ-5D-5L index value (Danish)	15D index value (Danish)	EQ-5D-5L index value (Hungarian)	15D index value (Norwegian)
	Mobility	**Self-care**	**Usual activities**	**Pain/discomfort**	**Anxiety/depression**					
15D										
Mobility	**0.559**	0.473	0.543	0.409	0.195	-0.399	-0.448	-0.572	-0.507	-0.560
Vision	0.299	0.307	0.325	0.319	0.292	-0.284	-0.382	-0.538	-0.387	-0.543
Hearing	0.188	0.284	0.220	0.197	0.177	-0.216	-0.232	-0.412	-0.248	-0.410
Breathing	0.415	0.367	0.436	0.409	0.320	-0.357	-0.456	-0.672	-0.481	-0.661
Sleeping	0.255	0.228	0.327	0.455	0.457	-0.336	-0.501	-0.640	-0.482	-0.644
Eating	0.067*	0.297	0.162	0.127	0.161	-0.088	-0.181	-0.379	-0.180	-0.375
Speech	0.111	0.323	0.234	0.195	0.282	-0.154	-0.281	-0.461	-0.271	-0.456
Excretion	0.224	0.227	0.284	0.311	0.289	-0.237	-0.343	-0.571	-0.344	-0.581
Usual activities	0.466	0.446	**0.625**	0.515	0.391	-0.474	-0.582	-0.708	-0.600	-0.705
Mental function	0.207	0.339	0.294	0.306	0.395	-0.228	-0.411	-0.578	-0.400	-0.569
Discomfort and symptoms	0.407	0.342	0.458	**0.616**	0.501	-0.503	-0.624	-0.754	-0.613	-0.756
Depression	0.191	0.266	0.325	0.418	**0.715**	-0.318	-0.608	-0.723	-0.544	-0.732
Distress	0.180	0.186	0.320	0.445	**0.686**	-0.333	-0.583	-0.690	-0.520	-0.705
Vitality	0.408	0.319	0.476	0.535	0.529	-0.500	-0.618	-0.784	-0.607	-0.784
Sexual activities	0.346	0.286	0.403	0.395	0.369	-0.350	-0.461	-0.652	-0.463	-0.664
EQ VAS	-0.516	-0.343	-0.507	-0.606	-0.413	-	-	-	-	-
EQ-5D-5L index value (Danish)	-0.641	-0.516	-0.683	-0.821	-0.800	0.590	-	-	-	-
15D index value (Danish)	-0.478	-0.440	-0.567	-0.634	-0.630	0.505	0.702	-	-	-
EQ-5D-5L index value (Hungarian)	-0.717	-0.569	-0.736	-0.839	-0.696	0.599	0.969	0.679	-	-
15D index value (Norwegian)	-0.472	-0.431	-0.561	-0.633	-0.637	0.507	0.697	0.998	0.671	-

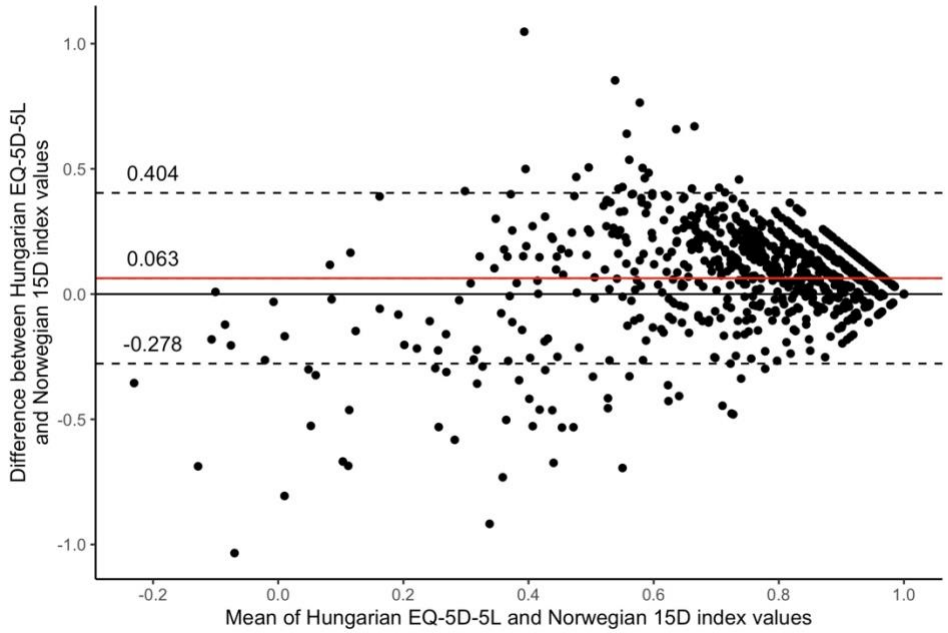
Pearson correlation coefficient was calculated for the continuous index values, while Spearman's rank correlation for the ordinal dimensions.
$p < 0.05$ for all correlation coefficients (two-tailed), except for those marked with asterisks.
Corresponding dimensions between EQ-5D-5L and 15D are in bold.

Appendix 12. Distribution of EQ-5D-5L and 15D index values among respondents with physical conditions (N=1195) (140)



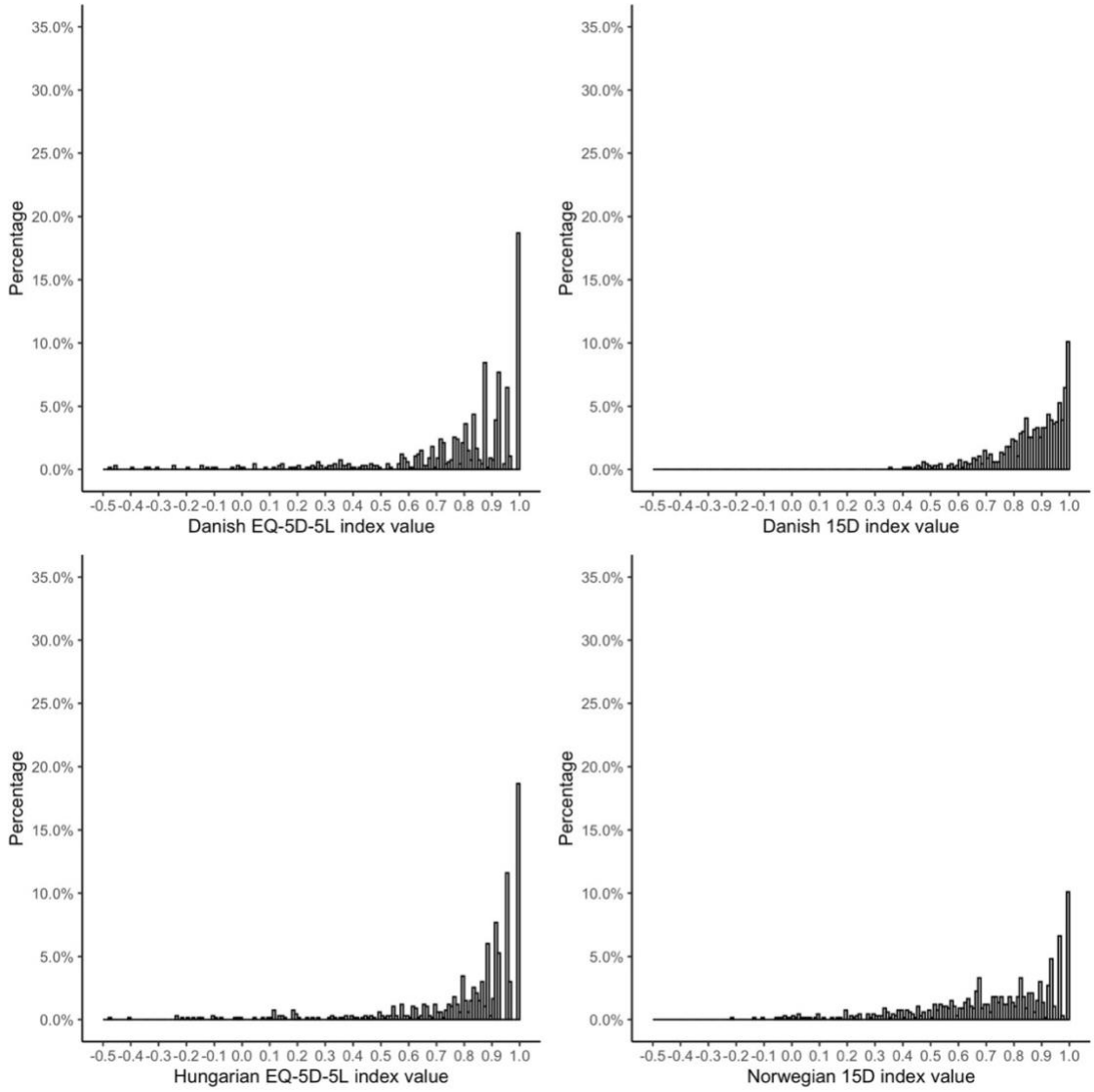
Appendix 13. Bland-Altman plot of EQ-5D-5L and 15D index values among respondents with physical conditions (N=1195) (140)



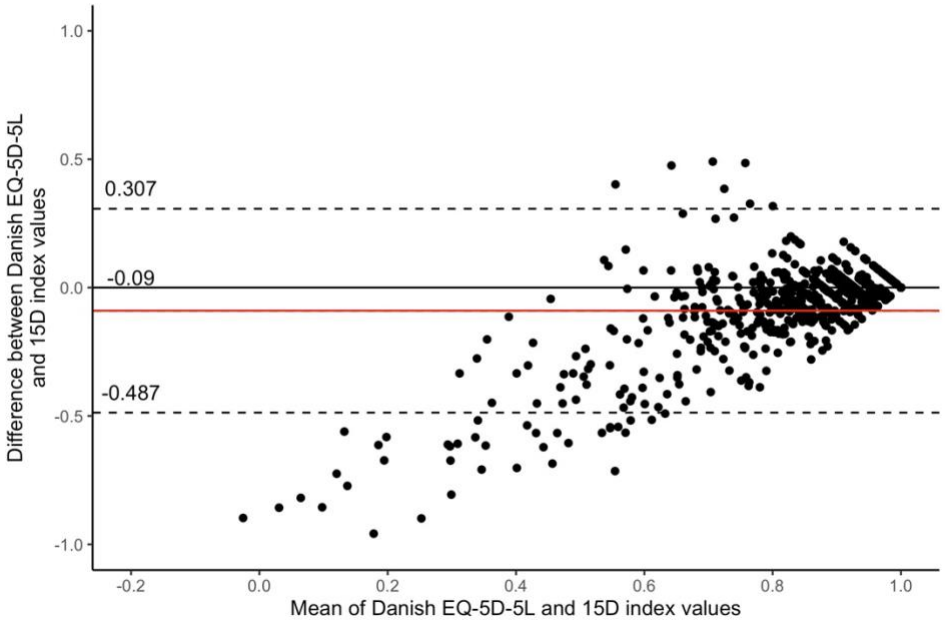


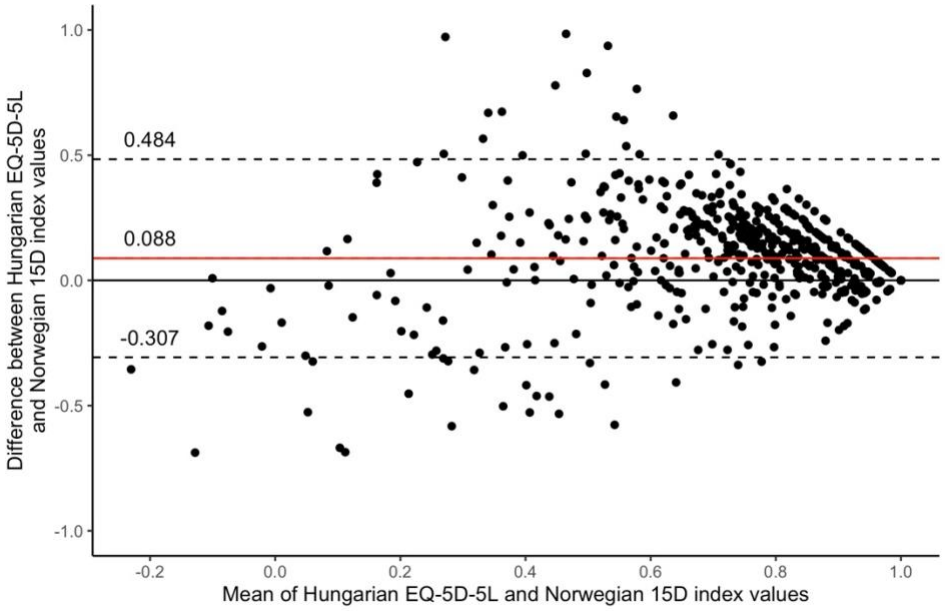
The horizontal red line represents the mean of the differences (D) between EQ-5D-5L and 15D index values, while the 95% confidence interval is represented by the dashed lines, which was obtained as D ± 1.96*SD (SD: standard deviation of the differences).

Appendix 14. Distribution of EQ-5D-5L and 15D index values among respondents with mental conditions (N=664) (140)



Appendix 15. Bland-Altman plot of EQ-5D-5L and 15D index values among respondents with mental conditions (N=664) (140)





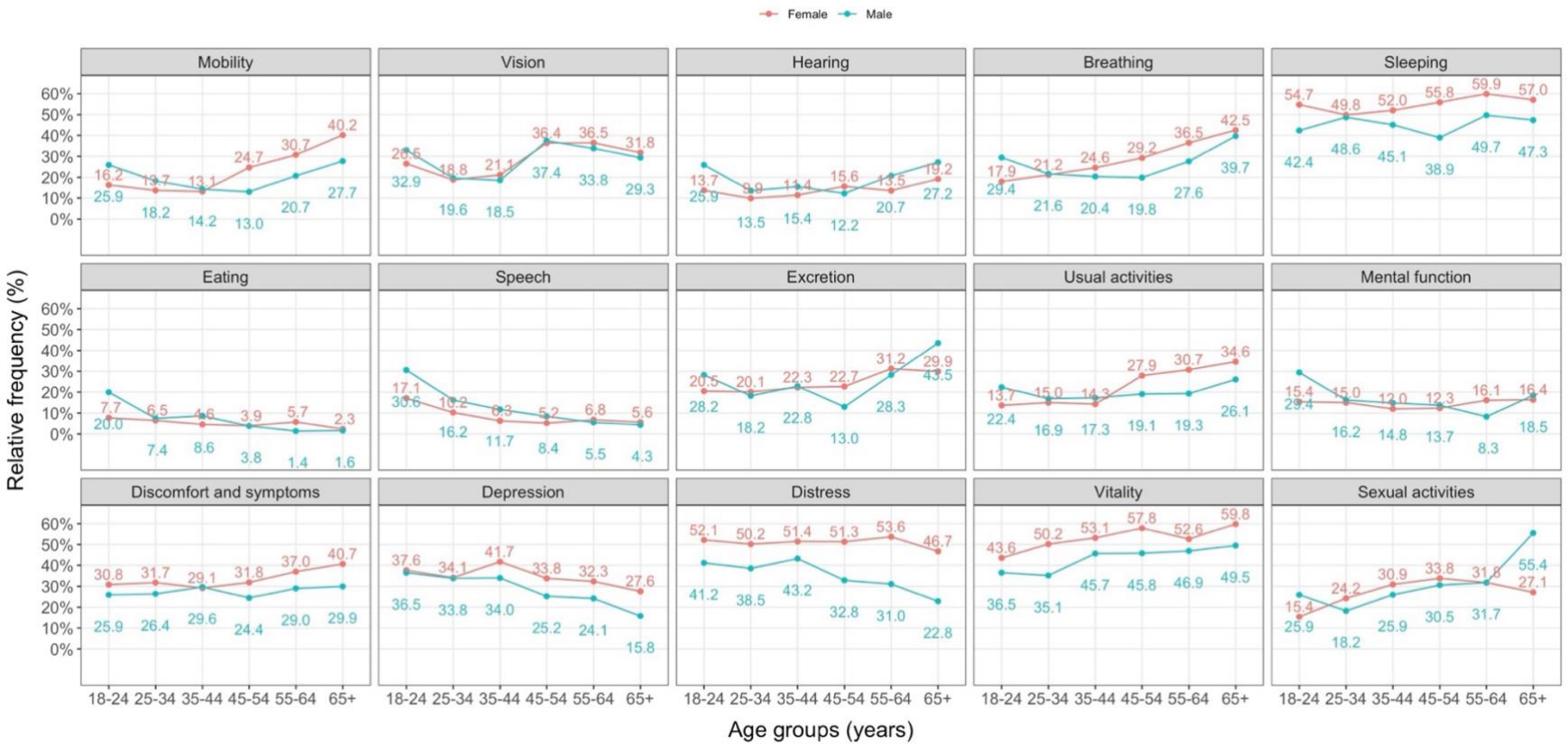
The horizontal red line represents the mean of the differences (D) between EQ-5D-5L and 15D index values, while the 95% confidence interval is represented by the dashed lines, which was obtained as D ± 1.96*SD (SD: standard deviation of the differences).

Appendix 16. Mean 15D index values according to sociodemographic and health-related characteristics (141)

Variables	Reference population (%) [a]	N	%	15D index value		
				Mean	95% CI	p-value [b]
Total	100	2000	100	0.810	0.800-0.819	-
Gender						
Male	46.9	855	42.8	0.820	0.805-0.835	0.0711
Female	53.1	1145	57.3	0.802	0.789-0.815	
Age groups (years)						
18-24	10.0	202	10.1	0.782	0.741-0.822	0.1286
25-34	15.2	441	22.1	0.823	0.801-0.844	
35-44	19.5	337	16.9	0.819	0.795-0.843	
45-54	16.0	285	14.3	0.825	0.802-0.848	
55-64	16.8	337	16.9	0.803	0.781-0.826	
65 and above	22.5	398	19.9	0.796	0.777-0.815	
Highest level of education						
Primary	23.8	544	27.2	0.775	0.753-0.796	<0.0001
Secondary	55.0	909	45.5	0.807	0.792-0.822	
Tertiary	21.2	547	27.4	0.849	0.835-0.863	
Settlement type						
Capital	17.9	390	19.5	0.825	0.806-0.845	0.0003
City	52.6	979	49.0	0.822	0.809-0.835	
Village	29.5	631	31.6	0.781	0.761-0.800	
Geographical region						
Central Hungary	30.4	619	31.0	0.811	0.794-0.827	0.9850
Great Plain and North	30.2	790	39.5	0.810	0.794-0.825	
Transdanubia	39.5	591	29.6	0.809	0.790-0.827	
Employment status						
Employed	53.1	1074	53.7	0.827	0.814-0.840	<0.0001
Retired	26.1	502	25.1	0.805	0.789-0.822	
Disability pensioner	3.1	55	2.8	0.559	0.486-0.631	
Student	3.1	68	3.4	0.853	0.807-0.900	
Unemployed	4.7	91	4.6	0.792	0.748-0.836	
Homemaker/housewife	1.0	49	2.5	0.801	0.746-0.857	
Other	8.9	161	8.1	0.787	0.745-0.830	
Marital status						
Married	45.6	825	41.3	0.835	0.822-0.848	<0.0001
Domestic partnership	13.4	417	20.9	0.834	0.814-0.853	
Single	18.5	472	23.6	0.767	0.743-0.791	
Widowed	11.4	129	6.5	0.780	0.741-0.819	
Divorced	11.1	157	7.9	0.766	0.729-0.803	
Household's per capita net monthly income (HUF) [c]						
1st quintile (≤ 75,000.3)	N/A	300	15.0	0.751	0.720-0.781	<0.0001
2nd quintile (75,000.3 & ≤112,500.5)	N/A	377	18.8	0.786	0.763-0.808	
3rd quintile (>112,500.5 & ≤142,500.3)	N/A	295	14.8	0.808	0.785-0.831	
4th quintile (>142,500.3 & ≤212,500.5)	N/A	373	18.6	0.828	0.808-0.848	
5th quintile (>212,500.5)	N/A	275	13.8	0.834	0.810-0.858	
Diagnosis of any chronic disease [c, d]						
Mental	48.0	168	8.4	0.795	0.754-0.835	<0.0001
Physical		726	36.3	0.842	0.830-0.853	
Both		535	26.8	0.698	0.678-0.717	
None	52.0	406	20.3	0.903	0.884-0.922	

CI confidence intervals.
a – Hungarian Central Statistical Office: Microcensus 2016.
b – Difference in index values between groups is tested by Student's t-test (two groups) or analysis of variance (three or more groups).
c – The number of respondents who responded "do not know" or refused to answer was n=380 (19.0%) for the household's per capita net monthly income and n=165 (8.3%) for the diagnosis of any chronic disease.
d – Hungarian Central Statistical Office: European Health Interview Survey in Hungary, 2019.
Totals may not add up to 100 by groups due to rounding. N/A = not available.

Appendix 17. Proportion of respondents reporting any problems in each domain by age and gender groups (141)



Appendix 18. 15D population norms by age group (total) (141)

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**202**	**10.1**	**441**	**22.1**	**337**	**16.9**	**285**	**14.3**	**337**	**16.9**	**398**	**19.9**	**2000**	**100.0**
Mobility														
I am able to walk normally (without difficulty) indoors, outdoors and on stairs.	161	79.7	374	84.8	291	86.4	230	80.7	248	73.6	261	65.6	1565	78.3
I am able to walk without difficulty indoors, but outdoors and/or on stairs I have slight difficulties.	22	10.9	43	9.8	31	9.2	37	13.0	63	18.7	96	24.1	292	14.6
I am able to walk without help indoors (with or without an appliance), but outdoors and/or on stairs only with considerable difficulty or with help from others.	10	5.0	16	3.6	11	3.3	15	5.3	23	6.8	37	9.3	112	5.6
I am able to walk indoors only with help from others.	3	1.5	3	0.7	4	1.2	1	0.4	3	0.9	2	0.5	16	0.8
I am completely bed-ridden and unable to move about.	6	3.0	5	1.1	0	0.0	2	0.7	0	0.0	2	0.5	15	0.8
Vision														
I see normally, i.e. I can read newspapers and TV text without difficulty (with or without glasses).	143	70.8	357	81.0	270	80.1	180	63.2	218	64.7	276	69.3	1444	72.2
I can read papers and/or TV text with slight difficulty (with or without glasses).	33	16.3	45	10.2	39	11.6	80	28.1	80	23.7	99	24.9	376	18.8
I can read papers and/or TV text with considerable difficulty (with or without glasses).	11	5.4	29	6.6	19	5.6	21	7.4	32	9.5	19	4.8	131	6.6
I cannot read papers or TV text either with glasses or without, but I can see enough to walk about without guidance.	6	3.0	6	1.4	7	2.1	3	1.1	6	1.8	4	1.0	32	1.6
I cannot see enough to walk about without a guide, i.e. I am almost or completely blind.	9	4.5	4	0.9	2	0.6	1	0.4	1	0.3	0	0.0	17	0.9
Hearing														
I can hear normally, i.e. normal speech (with or without a hearing aid).	164	81.2	392	88.9	292	86.6	245	86.0	281	83.4	307	77.1	1681	84.1
I hear normal speech with a little difficulty.	17	8.4	25	5.7	27	8.0	29	10.2	39	11.6	70	17.6	207	10.4
I hear normal speech with considerable difficulty; in conversation I need voices to be louder than normal.	12	5.9	20	4.5	16	4.7	8	2.8	16	4.7	17	4.3	89	4.5
I hear even loud voices poorly; I am almost deaf.	6	3.0	3	0.7	1	0.3	2	0.7	1	0.3	4	1.0	17	0.9
I am completely deaf.	3	1.5	1	0.2	1	0.3	1	0.4	0	0.0	0	0.0	6	0.3
Breathing														
I am able to breathe normally, i.e. with no shortness of breath or other breathing difficulty.	156	77.2	347	78.7	261	77.4	214	75.1	227	67.4	234	58.8	1439	72.0

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
I have shortness of breath during heavy work or sports, or when walking briskly on flat ground or slightly uphill.	27	13.4	66	15.0	55	16.3	55	19.3	81	24.0	128	32.2	412	20.6
I have shortness of breath when walking on flat ground at the same speed as others my age.	16	7.9	21	4.8	11	3.3	11	3.9	15	4.5	24	6.0	98	4.9
I get shortness of breath even after light activity, e.g. washing or dressing myself.	1	0.5	1	0.2	6	1.8	2	0.7	10	3.0	9	2.3	29	1.5
I have breathing difficulties almost all the time, even when resting.	2	1.0	6	1.4	4	1.2	3	1.1	4	1.2	3	0.8	22	1.1
Sleeping														
I am able to sleep normally, i.e. I have no problems with sleeping	102	50.5	223	50.6	173	51.3	148	51.9	150	44.5	189	47.5	985	49.3
I have slight problems with sleeping, e.g. difficulty in falling asleep, or sometimes waking at night.	58	28.7	148	33.6	107	31.8	91	31.9	125	37.1	150	37.7	679	34.0
I have moderate problems with sleeping, e.g. disturbed sleep, or feeling I have not slept enough.	32	15.8	58	13.2	45	13.4	35	12.3	45	13.4	42	10.6	257	12.9
I have great problems with sleeping, e.g. having to use sleeping pills often or routinely, or usually waking at night and/or too early in the morning.	5	2.5	10	2.3	12	3.6	10	3.5	12	3.6	16	4.0	65	3.3
I suffer severe sleeplessness, e.g. sleep is almost impossible even with full use of sleeping pills, or staying awake most of the night.	5	2.5	2	0.5	0	0.0	1	0.4	5	1.5	1	0.3	14	0.7
Eating														
I am able to eat normally, i.e. with no help from others	176	87.1	411	93.2	315	93.5	274	96.1	324	96.1	390	98.0	1890	94.5
I am able to eat by myself with minor difficulty (e.g. slowly, clumsily, shakily, or with special appliances).	10	5.0	13	2.9	11	3.3	7	2.5	9	2.7	7	1.8	57	2.9
I need some help from another person in eating.	9	4.5	12	2.7	9	2.7	3	1.1	3	0.9	1	0.3	37	1.9
I am unable to eat by myself at all, so I must be fed by another person.	5	2.5	4	0.9	2	0.6	1	0.4	1	0.3	0	0.0	13	0.7
I am unable to eat at all, so I am fed either by tube or intravenously.	2	1.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	3	0.2
Speech														
I am able to speak normally, i.e. clearly, audibly and fluently.	156	77.2	387	87.8	307	91.1	266	93.3	316	93.8	378	95.0	1810	90.5
I have slight speech difficulties, e.g. occasional fumbling for words, mumbling, or changes of pitch.	31	15.3	28	6.3	17	5.0	17	6.0	17	5.0	17	4.3	127	6.4
I can make myself understood, but my speech is e.g. disjointed, faltering, stuttering or stammering.	10	5.0	18	4.1	11	3.3	2	0.7	2	0.6	1	0.3	44	2.2
Most people have great difficulty understanding my speech.	3	1.5	4	0.9	2	0.6	0	0.0	2	0.6	2	0.5	13	0.7
I can only make myself understood by gestures.	2	1.0	4	0.9	0	0.0	0	0.0	0	0.0	0	0.0	6	0.3
Excretion														

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
My bladder and bowel work normally and without problems.	154	76.2	355	80.5	261	77.4	233	81.8	236	70.0	254	63.8	1493	74.7
I have slight problems with my bladder and/or bowel function, e.g. difficulties with urination, or loose or hard bowels.	28	13.9	61	13.8	62	18.4	41	14.4	83	24.6	125	31.4	400	20.0
I have marked problems with my bladder and/or bowel function, e.g. occasional 'accidents', or severe constipation or diarrhea.	10	5.0	15	3.4	12	3.6	9	3.2	13	3.9	17	4.3	76	3.8
I have serious problems with my bladder and/or bowel function, e.g. routine 'accidents', or need of catheterization or enemas.	4	2.0	7	1.6	2	0.6	2	0.7	2	0.6	0	0.0	17	0.9
I have no control over my bladder and/or bowel function.	6	3.0	3	0.7	0	0.0	0	0.0	3	0.9	2	0.5	14	0.7
Usual activities														
I am able to perform my usual activities (e.g. employment, studying, housework, freetime activities) without difficulty	167	82.7	372	84.4	284	84.3	217	76.1	250	74.2	276	69.3	1566	78.3
I am able to perform my usual activities slightly less effectively or with minor difficulty.	12	5.9	44	10.0	34	10.1	54	18.9	60	17.8	94	23.6	298	14.9
I am able to perform my usual activities much less effectively, with considerable difficulty, or not completely	12	5.9	17	3.9	12	3.6	9	3.2	20	5.9	21	5.3	91	4.6
I can only manage a small proportion of my previously usual activities.	6	3.0	6	1.4	6	1.8	5	1.8	7	2.1	7	1.8	37	1.9
I am unable to manage any of my previously usual activities.	5	2.5	2	0.5	1	0.3	0	0.0	0	0.0	0	0.0	8	0.4
Mental function														
I am able to think clearly and logically, and my memory functions well	159	78.7	373	84.6	292	86.6	248	87.0	294	87.2	329	82.7	1695	84.8
I have slight difficulties in thinking clearly and logically, or my memory sometimes fails me.	24	11.9	43	9.8	30	8.9	33	11.6	38	11.3	63	15.8	231	11.6
I have marked difficulties in thinking clearly and logically, or my memory is somewhat impaired.	10	5.0	18	4.1	11	3.3	4	1.4	2	0.6	4	1.0	49	2.5
I have great difficulties in thinking clearly and logically, or my memory is seriously impaired.	5	2.5	5	1.1	4	1.2	0	0.0	3	0.9	1	0.3	18	0.9
I am permanently confused and disoriented in place and time.	4	2.0	2	0.5	0	0.0	0	0.0	0	0.0	1	0.3	7	0.4
Discomfort and symptoms														
I have no physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	144	71.3	309	70.1	238	70.6	204	71.6	224	66.5	256	64.3	1375	68.8
I have mild physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	34	16.8	89	20.2	71	21.1	60	21.1	78	23.1	108	27.1	440	22.0
I have marked physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	14	6.9	29	6.6	20	5.9	16	5.6	24	7.1	29	7.3	132	6.6
I have severe physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	5	2.5	11	2.5	8	2.4	5	1.8	10	3.0	5	1.3	44	2.2

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
I have unbearable physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	5	2.5	3	0.7	0	0.0	0	0.0	1	0.3	0	0.0	9	0.5
Depression														
I do not feel at all sad, melancholic or depressed.	127	62.9	291	66.0	209	62.0	200	70.2	240	71.2	310	77.9	1377	68.9
I feel slightly sad, melancholic or depressed.	43	21.3	88	20.0	76	22.6	62	21.8	67	19.9	58	14.6	394	19.7
I feel moderately sad, melancholic or depressed.	17	8.4	42	9.5	35	10.4	16	5.6	23	6.8	23	5.8	156	7.8
I feel very sad, melancholic or depressed.	9	4.5	17	3.9	11	3.3	5	1.8	3	0.9	6	1.5	51	2.6
I feel extremely sad, melancholic or depressed.	6	3.0	3	0.7	6	1.8	2	0.7	4	1.2	1	0.3	22	1.1
Distress														
I do not feel at all anxious, stressed or nervous.	106	52.5	237	53.7	177	52.5	163	57.2	189	56.1	256	64.3	1128	56.4
I feel slightly anxious, stressed or nervous.	52	25.7	130	29.5	96	28.5	87	30.5	114	33.8	105	26.4	584	29.2
I feel moderately anxious, stressed or nervous.	28	13.9	41	9.3	33	9.8	22	7.7	18	5.3	29	7.3	171	8.6
I feel very anxious, stressed or nervous.	10	5.0	23	5.2	23	6.8	10	3.5	12	3.6	6	1.5	84	4.2
I feel extremely anxious, stressed or nervous.	6	3.0	10	2.3	8	2.4	3	1.1	4	1.2	2	0.5	33	1.7
Vitality														
I feel healthy and energetic.	120	59.4	242	54.9	170	50.4	136	47.7	168	49.9	179	45.0	1015	50.8
I feel slightly weary, tired or feeble.	44	21.8	117	26.5	115	34.1	109	38.2	117	34.7	157	39.4	659	33.0
I feel moderately weary, tired or feeble.	23	11.4	48	10.9	29	8.6	24	8.4	38	11.3	49	12.3	211	10.6
I feel very weary, tired or feeble, almost exhausted.	11	5.4	26	5.9	17	5.0	15	5.3	13	3.9	12	3.0	94	4.7
I feel extremely weary, tired or feeble, totally exhausted.	4	2.0	8	1.8	6	1.8	1	0.4	1	0.3	1	0.3	21	1.1
Sexual activity														
My state of health has no adverse effect on my sexual activity.	162	80.2	343	77.8	241	71.5	193	67.7	230	68.2	238	59.8	1407	70.4
My state of health has a slight effect on my sexual activity.	22	10.9	53	12.0	50	14.8	54	18.9	59	17.5	75	18.8	313	15.7
My state of health has a considerable effect on my sexual activity.	10	5.0	36	8.2	28	8.3	24	8.4	25	7.4	38	9.5	161	8.1
My state of health makes sexual activity almost impossible.	6	3.0	8	1.8	10	3.0	5	1.8	7	2.1	10	2.5	46	2.3
My state of health makes sexual activity impossible.	2	1.0	1	0.2	8	2.4	9	3.2	16	4.7	37	9.3	73	3.7

Totals may not add up to 100 % due to rounding.

Appendix 19. 15D population norms by age group (males) (141)

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**85**	**9.9**	**148**	**17.3**	**162**	**18.9**	**131**	**15.3**	**145**	**17.0**	**184**	**21.5**	**855**	**100.0**
Mobility														
I am able to walk normally (without difficulty) indoors, outdoors and on stairs.	63	74.1	121	81.8	139	85.8	114	87.0	115	79.3	133	72.3	685	80.1
I am able to walk without difficulty indoors, but outdoors and/or on stairs I have slight difficulties.	12	14.1	17	11.5	16	9.9	10	7.6	22	15.2	38	20.7	115	13.5
I am able to walk without help indoors (with or without an appliance), but outdoors and/or on stairs only with considerable difficulty or with help from others.	3	3.5	6	4.1	5	3.1	6	4.6	7	4.8	11	6.0	38	4.4
I am able to walk indoors only with help from others.	3	3.5	1	0.7	2	1.2	1	0.8	1	0.7	0	0.0	8	0.9
I am completely bed-ridden and unable to move about.	4	4.7	3	2.0	0	0.0	0	0.0	0	0.0	2	1.1	9	1.1
Vision														
I see normally, i.e. I can read newspapers and TV text without difficulty (with or without glasses).	57	67.1	119	80.4	132	81.5	82	62.6	96	66.2	130	70.7	616	72.0
I can read papers and/or TV text with slight difficulty (with or without glasses).	13	15.3	13	8.8	17	10.5	40	30.5	33	22.8	44	23.9	160	18.7
I can read papers and/or TV text with considerable difficulty (with or without glasses).	5	5.9	13	8.8	7	4.3	6	4.6	12	8.3	9	4.9	52	6.1
I cannot read papers or TV text either with glasses or without, but I can see enough to walk about without guidance.	5	5.9	3	2.0	5	3.1	3	2.3	3	2.1	1	0.5	20	2.3
I cannot see enough to walk about without a guide, i.e. I am almost or completely blind.	5	5.9	0	0.0	1	0.6	0	0.0	1	0.7	0	0.0	7	0.8
Hearing														
I can hear normally, i.e. normal speech (with or without a hearing aid).	63	74.1	128	86.5	137	84.6	115	87.8	115	79.3	134	72.8	692	80.9
I hear normal speech with a little difficulty.	11	12.9	10	6.8	15	9.3	13	9.9	21	14.5	42	22.8	112	13.1
I hear normal speech with considerable difficulty; in conversation I need voices to be louder than normal.	5	5.9	8	5.4	10	6.2	3	2.3	8	5.5	8	4.3	42	4.9
I hear even loud voices poorly; I am almost deaf.	4	4.7	2	1.4	0	0.0	0	0.0	1	0.7	0	0.0	7	0.8
I am completely deaf.	2	2.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
Breathing														
I am able to breathe normally, i.e. with no shortness of breath or other breathing difficulty.	60	70.6	116	78.4	129	79.6	105	80.2	105	72.4	111	60.3	626	73.2

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
I have shortness of breath during heavy work or sports, or when walking briskly on flat ground or slightly uphill.	14	16.5	23	15.5	24	14.8	23	17.6	33	22.8	59	32.1	176	20.6
I have shortness of breath when walking on flat ground at the same speed as others my age.	9	10.6	8	5.4	6	3.7	3	2.3	3	2.1	11	6.0	40	4.7
I get shortness of breath even after light activity, e.g. washing or dressing myself.	1	1.2	1	0.7	2	1.2	0	0.0	2	1.4	2	1.1	8	0.9
I have breathing difficulties almost all the time, even when resting.	1	1.2	0	0.0	1	0.6	0	0.0	2	1.4	1	0.5	5	0.6
Sleeping														
I am able to sleep normally, i.e. I have no problems with sleeping	49	57.6	76	51.4	89	54.9	80	61.1	73	50.3	97	52.7	464	54.3
I have slight problems with sleeping, e.g. difficulty in falling asleep, or sometimes waking at night.	16	18.8	47	31.8	53	32.7	38	29.0	52	35.9	69	37.5	275	32.2
I have moderate problems with sleeping, e.g. disturbed sleep, or feeling I have not slept enough.	16	18.8	18	12.2	16	9.9	13	9.9	15	10.3	12	6.5	90	10.5
I have great problems with sleeping, e.g. having to use sleeping pills often or routinely, or usually waking at night and/or too early in the morning.	2	2.4	6	4.1	4	2.5	0	0.0	4	2.8	6	3.3	22	2.6
I suffer severe sleeplessness, e.g. sleep is almost impossible even with full use of sleeping pills, or staying awake most of the night.	2	2.4	1	0.7	0	0.0	0	0.0	1	0.7	0	0.0	4	0.5
Eating														
I am able to eat normally, i.e. with no help from others	68	80.0	137	92.6	148	91.4	126	96.2	143	98.6	181	98.4	803	93.9
I am able to eat by myself with minor difficulty (e.g. slowly, clumsily, shakily, or with special appliances).	7	8.2	5	3.4	8	4.9	3	2.3	2	1.4	3	1.6	28	3.3
I need some help from another person in eating.	5	5.9	4	2.7	5	3.1	2	1.5	0	0.0	0	0.0	16	1.9
I am unable to eat by myself at all, so I must be fed by another person.	4	4.7	2	1.4	1	0.6	0	0.0	0	0.0	0	0.0	7	0.8
I am unable to eat at all, so I am fed either by tube or intravenously.	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Speech														
I am able to speak normally, i.e. clearly, audibly and fluently.	59	69.4	124	83.8	143	88.3	120	91.6	137	94.5	176	95.7	759	88.8
I have slight speech difficulties, e.g. occasional fumbling for words, mumbling, or changes of pitch.	16	18.8	14	9.5	11	6.8	10	7.6	7	4.8	7	3.8	65	7.6
I can make myself understood, but my speech is e.g. disjointed, faltering, stuttering or stammering.	8	9.4	8	5.4	6	3.7	1	0.8	1	0.7	1	0.5	25	2.9
Most people have great difficulty understanding my speech.	1	1.2	1	0.7	2	1.2	0	0.0	0	0.0	0	0.0	4	0.5
I can only make myself understood by gestures.	1	1.2	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
Excretion														

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
My bladder and bowel work normally and without problems.	61	71.8	121	81.8	125	77.2	114	87.0	104	71.7	104	56.5	629	73.6
I have slight problems with my bladder and/or bowel function, e.g. difficulties with urination, or loose or hard bowels.	10	11.8	17	11.5	29	17.9	11	8.4	38	26.2	73	39.7	178	20.8
I have marked problems with my bladder and/or bowel function, e.g. occasional 'accidents', or severe constipation or diarrhea.	7	8.2	8	5.4	7	4.3	5	3.8	3	2.1	7	3.8	37	4.3
I have serious problems with my bladder and/or bowel function, e.g. routine 'accidents', or need of catheterization or enemas.	3	3.5	2	1.4	1	0.6	1	0.8	0	0.0	0	0.0	7	0.8
I have no control over my bladder and/or bowel function.	4	4.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.5
Usual activities														
I am able to perform my usual activities (e.g. employment, studying, housework, freetime activities) without difficulty	66	77.6	123	83.1	134	82.7	106	80.9	117	80.7	136	73.9	682	79.8
I am able to perform my usual activities slightly less effectively or with minor difficulty.	6	7.1	18	12.2	18	11.1	21	16.0	19	13.1	41	22.3	123	14.4
I am able to perform my usual activities much less effectively, with considerable difficulty, or not completely	6	7.1	5	3.4	6	3.7	3	2.3	7	4.8	5	2.7	32	3.7
I can only manage a small proportion of my previously usual activities.	4	4.7	2	1.4	4	2.5	1	0.8	2	1.4	2	1.1	15	1.8
I am unable to manage any of my previously usual activities.	3	3.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.4
Mental function														
I am able to think clearly and logically, and my memory functions well	60	70.6	124	83.8	138	85.2	113	86.3	133	91.7	150	81.5	718	84.0
I have slight difficulties in thinking clearly and logically, or my memory sometimes fails me.	12	14.1	13	8.8	15	9.3	15	11.5	12	8.3	32	17.4	99	11.6
I have marked difficulties in thinking clearly and logically, or my memory is somewhat impaired.	8	9.4	7	4.7	7	4.3	3	2.3	0	0.0	2	1.1	27	3.2
I have great difficulties in thinking clearly and logically, or my memory is seriously impaired.	4	4.7	3	2.0	2	1.2	0	0.0	0	0.0	0	0.0	9	1.1
I am permanently confused and disoriented in place and time.	1	1.2	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
Discomfort and symptoms														
I have no physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	63	74.1	109	73.6	114	70.4	99	75.6	103	71.0	129	70.1	617	72.2
I have mild physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	8	9.4	21	14.2	35	21.6	28	21.4	29	20.0	46	25.0	167	19.5
I have marked physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	7	8.2	12	8.1	10	6.2	3	2.3	11	7.6	8	4.3	51	6.0
I have severe physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	4	4.7	5	3.4	3	1.9	1	0.8	2	1.4	1	0.5	16	1.9

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
I have unbearable physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	3	3.5	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	4	0.5
Depression														
I do not feel at all sad, melancholic or depressed.	54	63.5	98	66.2	107	66.0	98	74.8	110	75.9	155	84.2	622	72.7
I feel slightly sad, melancholic or depressed.	14	16.5	23	15.5	31	19.1	26	19.8	27	18.6	20	10.9	141	16.5
I feel moderately sad, melancholic or depressed.	6	7.1	18	12.2	15	9.3	5	3.8	7	4.8	6	3.3	57	6.7
I feel very sad, melancholic or depressed.	7	8.2	9	6.1	8	4.9	1	0.8	1	0.7	3	1.6	29	3.4
I feel extremely sad, melancholic or depressed.	4	4.7	0	0.0	1	0.6	1	0.8	0	0.0	0	0.0	6	0.7
Distress														
I do not feel at all anxious, stressed or nervous.	50	58.8	91	61.5	92	56.8	88	67.2	100	69.0	142	77.2	563	65.8
I feel slightly anxious, stressed or nervous.	17	20.0	30	20.3	44	27.2	36	27.5	40	27.6	35	19.0	202	23.6
I feel moderately anxious, stressed or nervous.	12	14.1	12	8.1	12	7.4	6	4.6	4	2.8	6	3.3	52	6.1
I feel very anxious, stressed or nervous.	3	3.5	11	7.4	11	6.8	0	0.0	1	0.7	1	0.5	27	3.2
I feel extremely anxious, stressed or nervous.	3	3.5	4	2.7	3	1.9	1	0.8	0	0.0	0	0.0	11	1.3
Vitality														
I feel healthy and energetic.	54	63.5	96	64.9	88	54.3	71	54.2	77	53.1	93	50.5	479	56.0
I feel slightly weary, tired or feeble.	13	15.3	24	16.2	52	32.1	50	38.2	52	35.9	71	38.6	262	30.6
I feel moderately weary, tired or feeble.	11	12.9	13	8.8	13	8.0	3	2.3	12	8.3	17	9.2	69	8.1
I feel very weary, tired or feeble, almost exhausted.	5	5.9	11	7.4	6	3.7	6	4.6	3	2.1	3	1.6	34	4.0
I feel extremely weary, tired or feeble, totally exhausted.	2	2.4	4	2.7	3	1.9	1	0.8	1	0.7	0	0.0	11	1.3
Sexual activity														
My state of health has no adverse effect on my sexual activity.	63	74.1	121	81.8	120	74.1	91	69.5	99	68.3	82	44.6	576	67.4
My state of health has a slight effect on my sexual activity.	8	9.4	13	8.8	19	11.7	24	18.3	26	17.9	49	26.6	139	16.3
My state of health has a considerable effect on my sexual activity.	9	10.6	11	7.4	12	7.4	10	7.6	11	7.6	22	12.0	75	8.8
My state of health makes sexual activity almost impossible.	4	4.7	2	1.4	8	4.9	1	0.8	5	3.4	6	3.3	26	3.0
My state of health makes sexual activity impossible.	1	1.2	1	0.7	3	1.9	5	3.8	4	2.8	25	13.6	39	4.6

Totals may not add up to 100 % due to rounding.

Appendix 20. 15D population norms by age group (females) (141)

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**117**	**10.2**	**293**	**25.6**	**175**	**15.3**	**154**	**13.4**	**192**	**16.8**	**214**	**18.7**	**1145**	**100.0**
Mobility														
I am able to walk normally (without difficulty) indoors, outdoors and on stairs.	98	83.8	253	86.3	152	86.9	116	75.3	133	69.3	128	59.8	880	76.9
I am able to walk without difficulty indoors, but outdoors and/or on stairs I have slight difficulties.	10	8.5	26	8.9	15	8.6	27	17.5	41	21.4	58	27.1	177	15.5
I am able to walk without help indoors (with or without an appliance), but outdoors and/or on stairs only with considerable difficulty or with help from others.	7	6.0	10	3.4	6	3.4	9	5.8	16	8.3	26	12.1	74	6.5
I am able to walk indoors only with help from others.	0	0.0	2	0.7	2	1.1	0	0.0	2	1.0	2	0.9	8	0.7
I am completely bed-ridden and unable to move about.	2	1.7	2	0.7	0	0.0	2	1.3	0	0.0	0	0.0	6	0.5
Vision														
I see normally, i.e. I can read newspapers and TV text without difficulty (with or without glasses).	86	73.5	238	81.2	138	78.9	98	63.6	122	63.5	146	68.2	828	72.3
I can read papers and/or TV text with slight difficulty (with or without glasses).	20	17.1	32	10.9	22	12.6	40	26.0	47	24.5	55	25.7	216	18.9
I can read papers and/or TV text with considerable difficulty (with or without glasses).	6	5.1	16	5.5	12	6.9	15	9.7	20	10.4	10	4.7	79	6.9
I cannot read papers or TV text either with glasses or without, but I can see enough to walk about without guidance.	1	0.9	3	1.0	2	1.1	0	0.0	3	1.6	3	1.4	12	1.0
I cannot see enough to walk about without a guide, i.e. I am almost or completely blind.	4	3.4	4	1.4	1	0.6	1	0.6	0	0.0	0	0.0	10	0.9
Hearing														
I can hear normally, i.e. normal speech (with or without a hearing aid).	101	86.3	264	90.1	155	88.6	130	84.4	166	86.5	173	80.8	989	86.4
I hear normal speech with a little difficulty.	6	5.1	15	5.1	12	6.9	16	10.4	18	9.4	28	13.1	95	8.3
I hear normal speech with considerable difficulty; in conversation I need voices to be louder than normal.	7	6.0	12	4.1	6	3.4	5	3.2	8	4.2	9	4.2	47	4.1
I hear even loud voices poorly; I am almost deaf.	2	1.7	1	0.3	1	0.6	2	1.3	0	0.0	4	1.9	10	0.9
I am completely deaf.	1	0.9	1	0.3	1	0.6	1	0.6	0	0.0	0	0.0	4	0.3
Breathing														
I am able to breathe normally, i.e. with no shortness of breath or other breathing difficulty.	96	82.1	231	78.8	132	75.4	109	70.8	122	63.5	123	57.5	813	71.0

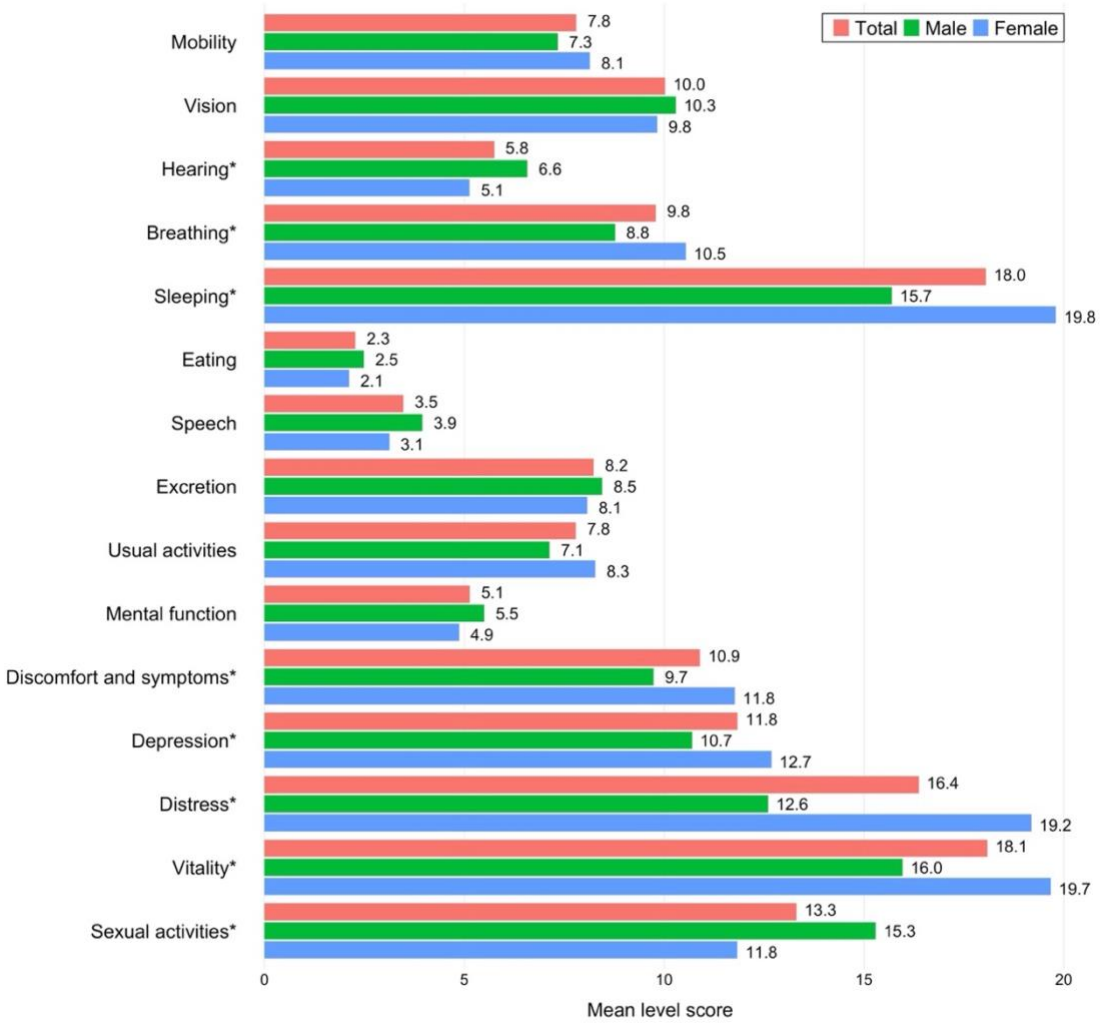
	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
I have shortness of breath during heavy work or sports, or when walking briskly on flat ground or slightly uphill.	13	11.1	43	14.7	31	17.7	32	20.8	48	25.0	69	32.2	236	20.6
I have shortness of breath when walking on flat ground at the same speed as others my age.	7	6.0	13	4.4	5	2.9	8	5.2	12	6.3	13	6.1	58	5.1
I get shortness of breath even after light activity, e.g. washing or dressing myself.	0	0.0	0	0.0	4	2.3	2	1.3	8	4.2	7	3.3	21	1.8
I have breathing difficulties almost all the time, even when resting.	1	0.9	6	2.0	3	1.7	3	1.9	2	1.0	2	0.9	17	1.5
Sleeping														
I am able to sleep normally, i.e. I have no problems with sleeping	53	45.3	147	50.2	84	48.0	68	44.2	77	40.1	92	43.0	521	45.5
I have slight problems with sleeping, e.g. difficulty in falling asleep, or sometimes waking at night.	42	35.9	101	34.5	54	30.9	53	34.4	73	38.0	81	37.9	404	35.3
I have moderate problems with sleeping, e.g. disturbed sleep, or feeling I have not slept enough.	16	13.7	40	13.7	29	16.6	22	14.3	30	15.6	30	14.0	167	14.6
I have great problems with sleeping, e.g. having to use sleeping pills often or routinely, or usually waking at night and/or too early in the morning.	3	2.6	4	1.4	8	4.6	10	6.5	8	4.2	10	4.7	43	3.8
I suffer severe sleeplessness, e.g. sleep is almost impossible even with full use of sleeping pills, or staying awake most of the night.	3	2.6	1	0.3	0	0.0	1	0.6	4	2.1	1	0.5	10	0.9
Eating														
I am able to eat normally, i.e. with no help from others	108	92.3	274	93.5	167	95.4	148	96.1	181	94.3	209	97.7	1087	94.9
I am able to eat by myself with minor difficulty (e.g. slowly, clumsily, shakily, or with special appliances).	3	2.6	8	2.7	3	1.7	4	2.6	7	3.6	4	1.9	29	2.5
I need some help from another person in eating.	4	3.4	8	2.7	4	2.3	1	0.6	3	1.6	1	0.5	21	1.8
I am unable to eat by myself at all, so I must be fed by another person.	1	0.9	2	0.7	1	0.6	1	0.6	1	0.5	0	0.0	6	0.5
I am unable to eat at all, so I am fed either by tube or intravenously.	1	0.9	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
Speech														
I am able to speak normally, i.e. clearly, audibly and fluently.	97	82.9	263	89.8	164	93.7	146	94.8	179	93.2	202	94.4	1051	91.8
I have slight speech difficulties, e.g. occasional fumbling for words, mumbling, or changes of pitch.	15	12.8	14	4.8	6	3.4	7	4.5	10	5.2	10	4.7	62	5.4
I can make myself understood, but my speech is e.g. disjointed, faltering, stuttering or stammering.	2	1.7	10	3.4	5	2.9	1	0.6	1	0.5	0	0.0	19	1.7
Most people have great difficulty understanding my speech.	2	1.7	3	1.0	0	0.0	0	0.0	2	1.0	2	0.9	9	0.8
I can only make myself understood by gestures.	1	0.9	3	1.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.3
Excretion														

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
My bladder and bowel work normally and without problems.	93	79.5	234	79.9	136	77.7	119	77.3	132	68.8	150	70.1	864	75.5
I have slight problems with my bladder and/or bowel function, e.g. difficulties with urination, or loose or hard bowels.	18	15.4	44	15.0	33	18.9	30	19.5	45	23.4	52	24.3	222	19.4
I have marked problems with my bladder and/or bowel function, e.g. occasional 'accidents', or severe constipation or diarrhea.	3	2.6	7	2.4	5	2.9	4	2.6	10	5.2	10	4.7	39	3.4
I have serious problems with my bladder and/or bowel function, e.g. routine 'accidents', or need of catheterization or enemas.	1	0.9	5	1.7	1	0.6	1	0.6	2	1.0	0	0.0	10	0.9
I have no control over my bladder and/or bowel function.	2	1.7	3	1.0	0	0.0	0	0.0	3	1.6	2	0.9	10	0.9
Usual activities														
I am able to perform my usual activities (e.g. employment, studying, housework, freetime activities) without difficulty	101	86.3	249	85.0	150	85.7	111	72.1	133	69.3	140	65.4	884	77.2
I am able to perform my usual activities slightly less effectively or with minor difficulty.	6	5.1	26	8.9	16	9.1	33	21.4	41	21.4	53	24.8	175	15.3
I am able to perform my usual activities much less effectively, with considerable difficulty, or not completely	6	5.1	12	4.1	6	3.4	6	3.9	13	6.8	16	7.5	59	5.2
I can only manage a small proportion of my previously usual activities.	2	1.7	4	1.4	2	1.1	4	2.6	5	2.6	5	2.3	22	1.9
I am unable to manage any of my previously usual activities.	2	1.7	2	0.7	1	0.6	0	0.0	0	0.0	0	0.0	5	0.4
Mental function														
I am able to think clearly and logically, and my memory functions well	99	84.6	249	85.0	154	88.0	135	87.7	161	83.9	179	83.6	977	85.3
I have slight difficulties in thinking clearly and logically, or my memory sometimes fails me.	12	10.3	30	10.2	15	8.6	18	11.7	26	13.5	31	14.5	132	11.5
I have marked difficulties in thinking clearly and logically, or my memory is somewhat impaired.	2	1.7	11	3.8	4	2.3	1	0.6	2	1.0	2	0.9	22	1.9
I have great difficulties in thinking clearly and logically, or my memory is seriously impaired.	1	0.9	2	0.7	2	1.1	0	0.0	3	1.6	1	0.5	9	0.8
I am permanently confused and disoriented in place and time.	3	2.6	1	0.3	0	0.0	0	0.0	0	0.0	1	0.5	5	0.4
Discomfort and symptoms														
I have no physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	81	69.2	200	68.3	124	70.9	105	68.2	121	63.0	127	59.3	758	66.2
I have mild physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	26	22.2	68	23.2	36	20.6	32	20.8	49	25.5	62	29.0	273	23.8
I have marked physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	7	6.0	17	5.8	10	5.7	13	8.4	13	6.8	21	9.8	81	7.1
I have severe physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	1	0.9	6	2.0	5	2.9	4	2.6	8	4.2	4	1.9	28	2.4

	18-24		25-34		35-44		45-54		55-64		65+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
I have unbearable physical discomfort or symptoms, e.g. pain, ache, nausea, itching etc.	2	1.7	2	0.7	0	0.0	0	0.0	1	0.5	0	0.0	5	0.4
Depression														
I do not feel at all sad, melancholic or depressed.	73	62.4	193	65.9	102	58.3	102	66.2	130	67.7	155	72.4	755	65.9
I feel slightly sad, melancholic or depressed.	29	24.8	65	22.2	45	25.7	36	23.4	40	20.8	38	17.8	253	22.1
I feel moderately sad, melancholic or depressed.	11	9.4	24	8.2	20	11.4	11	7.1	16	8.3	17	7.9	99	8.6
I feel very sad, melancholic or depressed.	2	1.7	8	2.7	3	1.7	4	2.6	2	1.0	3	1.4	22	1.9
I feel extremely sad, melancholic or depressed.	2	1.7	3	1.0	5	2.9	1	0.6	4	2.1	1	0.5	16	1.4
Distress														
I do not feel at all anxious, stressed or nervous.	56	47.9	146	49.8	85	48.6	75	48.7	89	46.4	114	53.3	565	49.3
I feel slightly anxious, stressed or nervous.	35	29.9	100	34.1	52	29.7	51	33.1	74	38.5	70	32.7	382	33.4
I feel moderately anxious, stressed or nervous.	16	13.7	29	9.9	21	12.0	16	10.4	14	7.3	23	10.7	119	10.4
I feel very anxious, stressed or nervous.	7	6.0	12	4.1	12	6.9	10	6.5	11	5.7	5	2.3	57	5.0
I feel extremely anxious, stressed or nervous.	3	2.6	6	2.0	5	2.9	2	1.3	4	2.1	2	0.9	22	1.9
Vitality														
I feel healthy and energetic.	66	56.4	146	49.8	82	46.9	65	42.2	91	47.4	86	40.2	536	46.8
I feel slightly weary, tired or feeble.	31	26.5	93	31.7	63	36.0	59	38.3	65	33.9	86	40.2	397	34.7
I feel moderately weary, tired or feeble.	12	10.3	35	11.9	16	9.1	21	13.6	26	13.5	32	15.0	142	12.4
I feel very weary, tired or feeble, almost exhausted.	6	5.1	15	5.1	11	6.3	9	5.8	10	5.2	9	4.2	60	5.2
I feel extremely weary, tired or feeble, totally exhausted.	2	1.7	4	1.4	3	1.7	0	0.0	0	0.0	1	0.5	10	0.9
Sexual activity														
My state of health has no adverse effect on my sexual activity.	99	84.6	222	75.8	121	69.1	102	66.2	131	68.2	156	72.9	831	72.6
My state of health has a slight effect on my sexual activity.	14	12.0	40	13.7	31	17.7	30	19.5	33	17.2	26	12.1	174	15.2
My state of health has a considerable effect on my sexual activity.	1	0.9	25	8.5	16	9.1	14	9.1	14	7.3	16	7.5	86	7.5
My state of health makes sexual activity almost impossible.	2	1.7	6	2.0	2	1.1	4	2.6	2	1.0	4	1.9	20	1.7
My state of health makes sexual activity impossible.	1	0.9	0	0.0	5	2.9	4	2.6	12	6.3	12	5.6	34	3.0

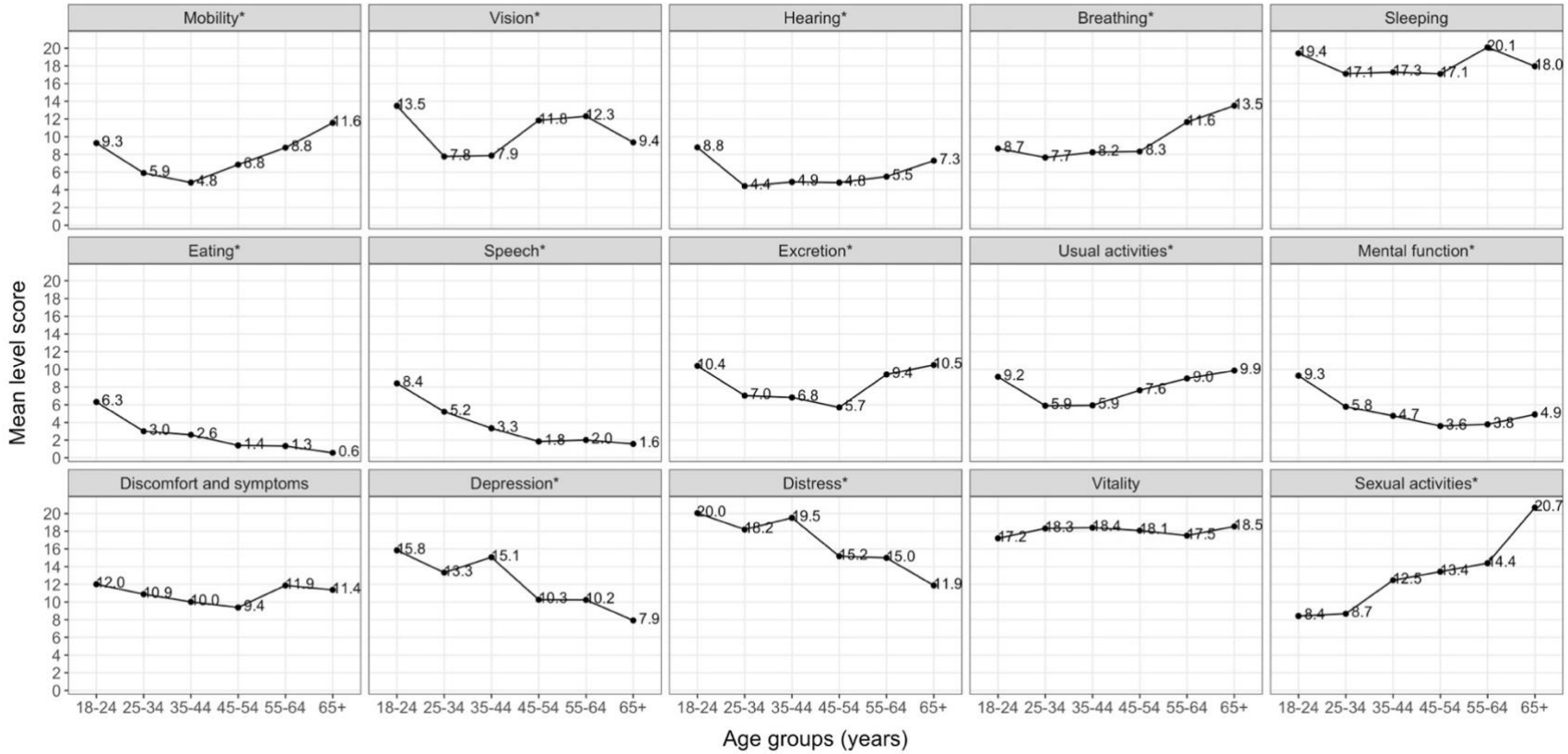
Totals may not add up to 100 % due to rounding.

Appendix 21. Mean level scores in 15D domains (141)



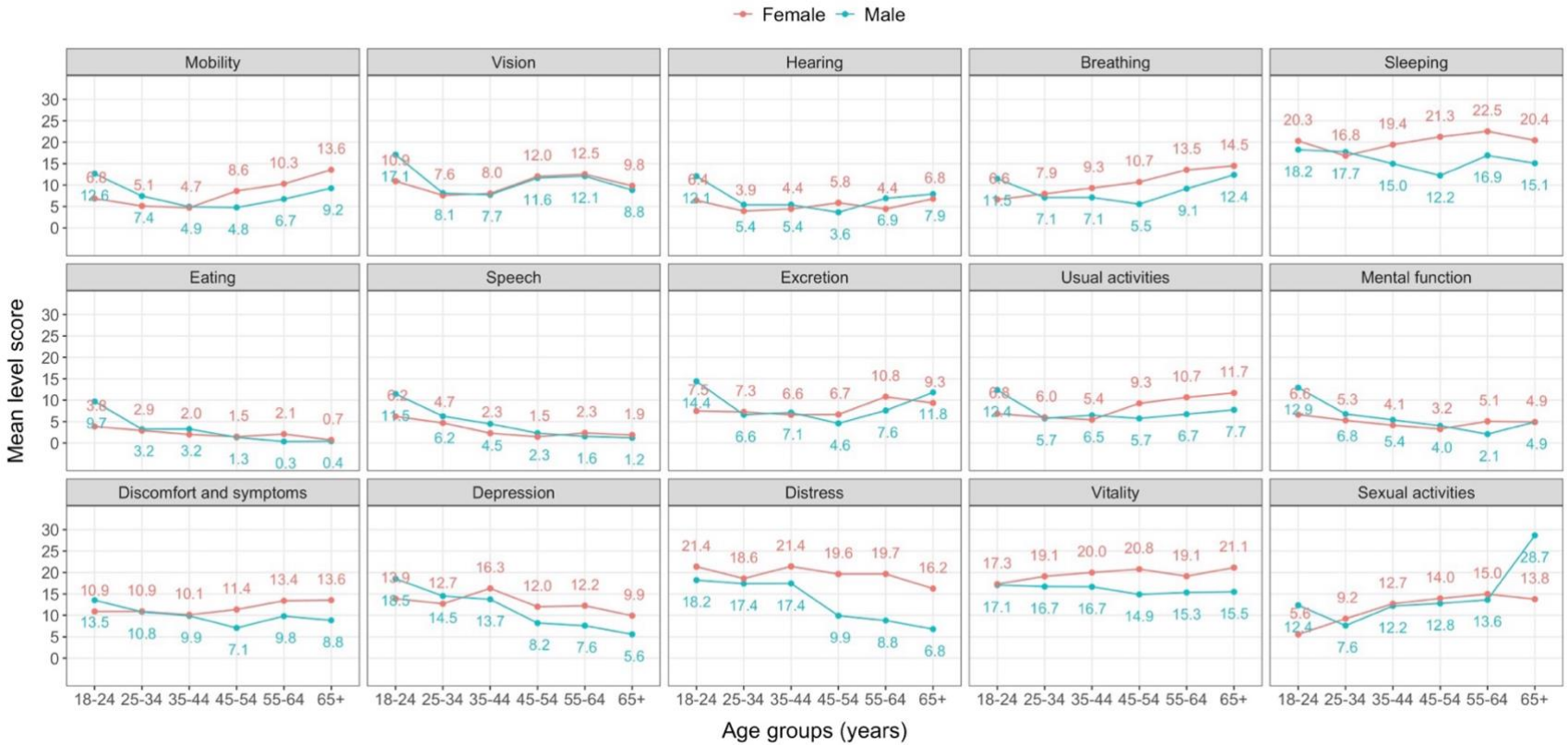
Student's t-test was performed to assess the mean level score difference between genders. All domains where p-value was <0.05 are marked with asterisks.
The LS ranges from 0 to 100.

Appendix 22. Mean level scores in each domain by age groups (141)



Analysis of variance was performed to assess the mean level score difference between age groups. All domains where p-value was <0.05 are marked with asterisks.
The LS ranges from 0 to 100.

Appendix 23. Mean level scores in each domain by gender and age groups (141)



The LS ranges from 0 to 100.

Appendix 24. Mean EQ VAS scores and EQ-5D-5L, PROPr and SF-6D index values according to sociodemographic and health-related characteristics (135)

Variables	Reference population (%) [a]	N	%	EQ VAS		EQ-5D-5L (Hun)		PROPr (US)		SF-6D (UK)	
				Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Highest level of education					**		***		***		***
Primary school or less	23.8	436	26.7	75.09	72.99-77.19	0.853	0.830-0.876	0.485	0.459-0.511	0.733	0.717-0.748
Secondary school	55.0	652	40.0	78.12	76.65-79.59	0.907	0.896-0.919	0.528	0.509-0.546	0.754	0.743-0.764
College/university degree	21.2	543	33.3	79.62	78.20-81.04	0.928	0.918-0.938	0.584	0.565-0.603	0.775	0.764-0.786
Place of residence							*		**		**
Capital	17.9	370	22.7	76.88	74.80-78.97	0.903	0.886-0.920	0.546	0.521-0.572	0.759	0.744-0.773
Other town	52.6	785	48.1	78.85	77.54-80.15	0.908	0.897-0.919	0.548	0.531-0.566	0.764	0.755-0.774
Village	29.5	476	29.2	76.82	75.04-78.61	0.884	0.866-0.901	0.505	0.482-0.527	0.737	0.724-0.750
Geographical region									**		
Central Hungary	30.4	559	34.3	77.41	75.76-79.05	0.905	0.892-0.918	0.551	0.531-0.571	0.759	0.748-0.771
Eastern Hungary	30.2	467	28.6	78	76.45-79.55	0.897	0.884-0.911	0.508	0.488-0.527	0.750	0.738-0.761
Western Hungary	39.5	605	37.1	78.05	76.32-79.77	0.896	0.878-0.913	0.552	0.529-0.575	0.757	0.745-0.770
Employment status					***		***		***		***
Employed	53.1	834	51.1	80.21	79.04-81.38	0.931	0.922-0.939	0.562	0.546-0.578	0.774	0.765-0.783
Retired	26.1	390	23.9	74.27	72.28-76.26	0.866	0.846-0.886	0.541	0.516-0.566	0.745	0.730-0.759
Disability pensioner	3.1	63	3.9	61.3	54.92-67.68	0.650	0.555-0.745	0.331	0.268-0.394	0.636	0.594-0.677
Student	3.1	72	4.4	83.31	79.17-87.44	0.943	0.923-0.963	0.515	0.465-0.566	0.761	0.734-0.788
Unemployed	4.7	117	7.2	72.91	68.24-77.59	0.869	0.830-0.908	0.496	0.443-0.550	0.730	0.700-0.760
Homemaker/housewife	1.0	91	5.6	83.01	79.65-86.37	0.933	0.913-0.953	0.499	0.450-0.548	0.746	0.717-0.775
Other	8.9	64	3.9	79.7	75.75-83.66	0.908	0.875-0.941	0.494	0.429-0.559	0.747	0.714-0.779
Marital status									*		
Married	45.6	694	42.6	77.99	76.62-79.36	0.903	0.889-0.916	0.555	0.537-0.574	0.761	0.750-0.771
Domestic partnership	13.4	341	20.9	78.96	76.90-81.03	0.905	0.889-0.921	0.531	0.506-0.556	0.747	0.732-0.762
Single	18.5	327	20.0	77.57	75.39-79.75	0.904	0.886-0.921	0.512	0.484-0.539	0.755	0.740-0.770
Widowed	11.4	96	5.9	75.91	71.92-79.89	0.875	0.837-0.913	0.545	0.495-0.595	0.752	0.721-0.782

Variables	Reference population (%) [a]	N	%	EQ VAS		EQ-5D-5L (Hun)		PROPr (US)		SF-6D (UK)	
				Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Divorced	11.1	143	8.8	75.27	71.49-79.05	0.871	0.835-0.907	0.514	0.470-0.559	0.752	0.725-0.779
Other	-	30	1.8	81.47	75.32-87.61	0.945	0.914-0.976	0.435	0.349-0.522	0.753	0.711-0.794
Self-perceived health					***		***		***		***
Excellent	N/A	134	8.2	93.04	90.66-95.42	0.978	0.967-0.990	0.688	0.647-0.730	0.886	0.866-0.905
Very good	N/A	386	23.7	88.75	87.89-89.61	0.972	0.966-0.979	0.670	0.649-0.690	0.834	0.823-0.845
Good	N/A	658	40.3	81.02	80.01-82.03	0.939	0.933-0.946	0.559	0.543-0.576	0.765	0.757-0.774
Fair	N/A	367	22.5	64.09	62.15-66.03	0.822	0.804-0.840	0.380	0.360-0.400	0.660	0.649-0.671
Poor	N/A	86	5.3	38.98	34.88-43.07	0.478	0.404-0.552	0.171	0.139-0.202	0.525	0.504-0.547
History of chronic illness [b, c]					***		***		***		***
Yes	48.0	1099	67.4	74.19	72.99-75.39	0.871	0.860-0.882	0.494	0.480-0.509	0.724	0.716-0.733
No	52.0	396	24.3	86.66	85.29-88.03	0.966	0.956-0.977	0.652	0.629-0.675	0.834	0.822-0.846
Weekly physical work/sport/exercise [b, c]					***		***		***		***
Less than 150 minutes	35.0	542	33.2	74.71	72.92-76.51	0.877	0.860-0.894	0.490	0.469-0.511	0.738	0.725-0.750
At least 150 minutes	65.0	1083	66.4	79.40	78.32-80.48	0.911	0.902-0.920	0.558	0.543-0.573	0.764	0.756-0.772
Smoking [b, c]							**				*
Currently smoking	27.2	420	25.8	77.07	75.09-79.09	0.888	0.870-0.905	0.514	0.489-0.538	0.743	0.729-0.757
Quit smoking less than a year ago	18.0	42	2.6	77.67	70.47-84.87	0.878	0.791-0.966	0.528	0.443-0.614	0.728	0.683-0.774
Quit smoking more than a year ago		352	21.6	76.42	74.37-78.48	0.885	0.865-0.904	0.540	0.515-0.564	0.755	0.741-0.769
Never smoked	54.9	771	47.3	79.18	77.91-80.46	0.916	0.906-0.926	0.551	0.534-0.568	0.765	0.755-0.775
Taking medication(s) regularly [c]					***		***		***		***
1-4 types	N/A	573	35.1	77.38	75.94-78.82	0.905	0.894-0.916	0.533	0.514-0.552	0.745	0.735-0.756
5 or more types (i.e., polypharmacy)	N/A	197	12.1	65.79	62.53-69.05	0.752	0.709-0.795	0.410	0.375-0.445	0.671	0.650-0.692
Do not take medication regularly	N/A	791	48.5	81.19	79.91-82.47	0.932	0.922-0.941	0.570	0.553-0.587	0.783	0.774-0.793
Alcohol consumption [b, c]					***		**		***		**
Every day or almost every day	N/A	47	2.9	74.68	68.3-81.061	0.873	0.803-0.943	0.485	0.405-0.565	0.740	0.699-0.780
5-6 day a week	N/A	89	5.5	74.98	70.85-79.10	0.894	0.855-0.932	0.526	0.472-0.579	0.739	0.711-0.767
3-4 days a week	N/A	234	14.3	81.77	79.88-83.66	0.920	0.901-0.940	0.600	0.571-0.628	0.774	0.757-0.791

Variables	Reference population (%) [a]	N	%	EQ VAS		EQ-5D-5L (Hun)		PROPr (US)		SF-6D (UK)	
				Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
1-2 days a week	N/A	208	12.8	78.34	75.77-80.91	0.905	0.883-0.927	0.555	0.524-0.587	0.767	0.748-0.785
2-3 days a month	N/A	129	7.9	78.93	75.58-82.28	0.910	0.878-0.943	0.549	0.506-0.593	0.760	0.734-0.786
Once a month	N/A	404	24.8	79.08	77.30-80.86	0.913	0.899-0.928	0.552	0.529-0.576	0.759	0.746-0.773
Less often than once a month	N/A	127	7.8	71.71	67.79-75.63	0.849	0.811-0.887	0.468	0.423-0.512	0.704	0.678-0.730
Not once in the last 12 months	N/A	273	16.7	76.93	74.36-79.50	0.882	0.859-0.904	0.501	0.470-0.532	0.754	0.736-0.772
Never	N/A	28	1.7	81.21	73.04-89.39	0.961	0.939-0.984	0.407	0.305-0.509	0.759	0.715-0.802
Body mass index [d]				***		***		*		***	
Underweight (below 18.5)	2.7	52	3.2	78.14	73.09-83.18	0.917	0.886-0.948	0.508	0.446-0.571	0.731	0.695-0.767
Normal (between 18.5 and 24.9)	39.1	468	28.7	80.53	78.82-82.24	0.919	0.906-0.933	0.556	0.534-0.578	0.768	0.755-0.780
Overweight (between 25 and 29.9)	34.3	521	31.9	78.47	76.93-80.00	0.911	0.897-0.924	0.562	0.540-0.583	0.772	0.760-0.784
Obese (30 or over)	23.9	361	22.1	75.14	73.12-77.16	0.873	0.853-0.893	0.518	0.493-0.543	0.732	0.718-0.747
Informal caregiver [e]								*		***	
Yes	N/A	323	19.8	77.55	75.43-79.66	0.883	0.863-0.903	0.509	0.481-0.536	0.731	0.716-0.747
No	N/A	1308	80.2	77.88	76.82-78.93	0.904	0.894-0.913	0.542	0.528-0.555	0.761	0.753-0.769
Household's per capita net monthly income (HUF) [c, d]				**		***		***		***	
1st quintile (≤123,744.4)	N/A	210	12.9	73.1	69.78-76.42	0.837	0.801-0.873	0.437	0.400-0.474	0.702	0.679-0.724
2nd quintile (>123,744.4 & ≤175,001)	N/A	241	14.8	74.83	72.23-77.42	0.877	0.853-0.900	0.474	0.444-0.505	0.723	0.704-0.742
3rd quintile (>175,001 & ≤229,810.4)	N/A	220	13.5	77.59	75.12-80.07	0.895	0.872-0.918	0.559	0.527-0.591	0.757	0.737-0.776
4th quintile (>229,810.4 & ≤300,521.1)	N/A	196	12.0	79.01	76.52-81.50	0.907	0.885-0.929	0.554	0.518-0.590	0.764	0.745-0.783
5th quintile (>300,521.1)	N/A	411	25.2	79.66	77.97-81.36	0.914	0.900-0.929	0.566	0.544-0.588	0.772	0.760-0.785

a – Hungarian Central Statistical Office: Microcensus 2016.
b – Hungarian Central Statistical Office: European Health Interview Survey in Hungary, 2019.
c – In the questionnaire, the categories "do not know" and/or "refused to answer" were among the possible answers in the nominated subgroups, but we did not include them in the calculations. The number of respondents reported these answers in the questionnaire is as follows. History of chronic illness: 136 (8.3%); Weekly physical work/sport/exercise: 6 (0.4%); Smoking: 46 (2.8%); Taking medication(s) regularly: 70 (4.3%); Alcohol consumption: 47 (2.9%); Household's per capita net monthly income (HUF): 353 (21.6%).
d – Figure was cleaned to remove any outliers.
e – Providing unpaid care or assistance to a family member, friend or other acquaintance who needs help with physical or mental health problems or problems related to aging.
Totals may not add up to 100 % due to rounding.
EQ VAS = EuroQol Visual Analogue Scale; PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions; N/A = not available
Difference in index values between groups was tested by Student's t-test (two categories) or analysis of variance (three or more categories). Asterisks indicate a significant difference (p-value < 0.05) in the categories of each variable. The significance level of variables is marked as follows. '***': <0.001; '**': <0.01; '*': <0.05; otherwise: p-value≥0.05.

Appendix 25. EQ-5D-5L population norms by age group (total) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		TOTAL	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	**141**	**8.6**	**284**	**17.4**	**295**	**18.1**	**281**	**17.2**	**287**	**17.6**	**288**	**17.7**	**55**	**3.4**	**1631**	**100.0**
MOBILITY																
No problems in walking about	133	94.3	250	88.0	235	79.7	198	70.5	168	58.5	148	51.4	16	29.1	1148	70.4
Slight problems in walking about	7	5.0	24	8.5	39	13.2	44	15.7	61	21.3	75	26.0	20	36.4	270	16.6
Moderate problems in walking about	1	0.7	8	2.8	18	6.1	27	9.6	35	12.2	47	16.3	11	20.0	147	9.0
Severe problems in walking about	0	0.0	2	0.7	3	1.0	12	4.3	22	7.7	18	6.3	8	14.5	65	4.0
Unable to walk	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	1	0.1
SELF-CARE																
No problems washing or dressing	137	97.2	271	95.4	285	96.6	260	92.5	261	90.9	251	87.2	44	80.0	1509	92.5
Slight problems washing or dressing	3	2.1	10	3.5	4	1.4	11	3.9	13	4.5	19	6.6	8	14.5	68	4.2
Moderate problems washing or dressing	0	0.0	3	1.1	3	1.0	8	2.8	7	2.4	14	4.9	1	1.8	36	2.2
Severe problems washing or dressing	1	0.7	0	0.0	2	0.7	2	0.7	4	1.4	4	1.4	2	3.6	15	0.9
Unable to wash or dress	0	0.0	0	0.0	1	0.3	0	0.0	2	0.7	0	0.0	0	0.0	3	0.2
USUAL ACTIVITES																
No problems doing usual activities	119	84.4	244	85.9	249	84.4	220	78.3	220	76.7	196	68.1	37	67.3	1285	78.8
Slight problems doing usual activities	20	14.2	28	9.9	36	12.2	35	12.5	34	11.8	65	22.6	13	23.6	231	14.2
Moderate problems doing usual activities	1	0.7	9	3.2	6	2.0	18	6.4	25	8.7	19	6.6	3	5.5	81	5.0
Severe problems doing usual activities	1	0.7	3	1.1	3	1.0	7	2.5	8	2.8	8	2.8	2	3.6	32	2.0
Unable to do usual activities	0	0.0	0	0.0	1	0.3	1	0.4	0	0.0	0	0.0	0	0.0	2	0.1
PAIN/DISCOMFORT																
No pain or discomfort	95	67.4	167	58.8	175	59.3	167	59.4	154	53.7	135	46.9	23	41.8	916	56.2
Slight pain or discomfort	37	26.2	80	28.2	92	31.2	73	26.0	87	30.3	109	37.8	23	41.8	501	30.7
Moderate pain or discomfort	7	5.0	29	10.2	25	8.5	33	11.7	32	11.1	30	10.4	9	16.4	165	10.1
Severe pain or discomfort	1	0.7	8	2.8	3	1.0	7	2.5	12	4.2	10	3.5	0	0.0	41	2.5
Extreme pain or discomfort	1	0.7	0	0.0	0	0.0	1	0.4	2	0.7	4	1.4	0	0.0	8	0.5
ANXIETY/DEPRESSION																
Not anxious or depressed	80	56.7	166	58.5	186	63.1	188	66.9	199	69.3	215	74.7	44	80.0	1078	66.1
Slightly anxious or depressed	43	30.5	74	26.1	74	25.1	57	20.3	55	19.2	55	19.1	9	16.4	367	22.5
Moderately anxious or depressed	12	8.5	29	10.2	27	9.2	28	10.0	26	9.1	13	4.5	2	3.6	137	8.4
Severely anxious or depressed	4	2.8	9	3.2	5	1.7	6	2.1	6	2.1	3	1.0	0	0.0	33	2.0
Extremely anxious or depressed	2	1.4	6	2.1	3	1.0	2	0.7	1	0.3	2	0.7	0	0.0	16	1.0

Totals may not add up to 100% due to rounding.

Appendix 26. EQ-5D-5L population norms by age group (males) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		TOTAL	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**29**	**4.0**	**88**	**12.2**	**135**	**18.8**	**139**	**19.3**	**137**	**19.0**	**150**	**20.8**	**42**	**5.8**	**720**	**100.0**
MOBILITY																
No problems in walking about	26	89.7	78	88.6	112	83.0	105	75.5	85	62.0	85	56.7	15	35.7	506	70.3
Slight problems in walking about	3	10.3	7	8.0	18	13.3	20	14.4	23	16.8	39	26.0	13	31.0	123	17.1
Moderate problems in walking about	0	0.0	2	2.3	5	3.7	11	7.9	15	10.9	20	13.3	8	19.0	61	8.5
Severe problems in walking about	0	0.0	1	1.1	0	0.0	3	2.2	14	10.2	6	4.0	6	14.3	30	4.2
Unable to walk	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
SELF-CARE																
No problems washing or dressing	27	93.1	83	94.3	129	95.6	132	95.0	123	89.8	129	86.0	35	83.3	658	91.4
Slight problems washing or dressing	2	6.9	4	4.5	2	1.5	5	3.6	8	5.8	9	6.0	5	11.9	35	4.9
Moderate problems washing or dressing	0	0.0	1	1.1	3	2.2	2	1.4	4	2.9	9	6.0	0	0.0	19	2.6
Severe problems washing or dressing	0	0.0	0	0.0	1	0.7	0	0.0	1	0.7	3	2.0	2	4.8	7	1.0
Unable to wash or dress	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0	0	0.0	1	0.1
USUAL ACTIVITES																
No problems doing usual activities	23	79.3	78	88.6	119	88.1	117	84.2	108	78.8	107	71.3	31	73.8	583	81.0
Slight problems doing usual activities	5	17.2	4	4.5	12	8.9	15	10.8	15	10.9	28	18.7	7	16.7	86	11.9
Moderate problems doing usual activities	0	0.0	4	4.5	3	2.2	3	2.2	10	7.3	8	5.3	2	4.8	30	4.2
Severe problems doing usual activities	1	3.4	2	2.3	1	0.7	4	2.9	4	2.9	7	4.7	2	4.8	21	2.9
Unable to do usual activities	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
PAIN/DISCOMFORT																
No pain or discomfort	26	89.7	59	67.0	89	65.9	92	66.2	77	56.2	78	52.0	22	52.4	443	61.5
Slight pain or discomfort	3	10.3	15	17.0	33	24.4	31	22.3	40	29.2	53	35.3	15	35.7	190	26.4
Moderate pain or discomfort	0	0.0	9	10.2	13	9.6	13	9.4	13	9.5	13	8.7	5	11.9	66	9.2
Severe pain or discomfort	0	0.0	5	5.7	0	0.0	2	1.4	6	4.4	6	4.0	0	0.0	19	2.6
Extreme pain or discomfort	0	0.0	0	0.0	0	0.0	1	0.7	1	0.7	0	0.0	0	0.0	2	0.3
ANXIETY/DEPRESSION																
Not anxious or depressed	20	69.0	61	69.3	90	66.7	106	76.3	99	72.3	126	84.0	35	83.3	537	74.6
Slightly anxious or depressed	7	24.1	17	19.3	30	22.2	20	14.4	26	19.0	19	12.7	5	11.9	124	17.2
Moderately anxious or depressed	2	6.9	8	9.1	14	10.4	9	6.5	9	6.6	4	2.7	2	4.8	48	6.7
Severely anxious or depressed	0	0.0	1	1.1	1	0.7	4	2.9	3	2.2	1	0.7	0	0.0	10	1.4
Extremely anxious or depressed	0	0.0	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1

Totals may not add up to 100% due to rounding.

Appendix 27. EQ-5D-5L population norms by age group (females) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		TOTAL	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	**112**	**12.3**	**196**	**21.5**	**160**	**17.6**	**142**	**15.6**	**150**	**16.5**	**138**	**15.1**	**13**	**1.4**	**911**	**100.0**
MOBILITY																
No problems in walking about	107	95.5	172	87.8	123	76.9	93	65.5	83	55.3	63	45.7	1	7.7	642	70.5
Slight problems in walking about	4	3.6	17	8.7	21	13.1	24	16.9	38	25.3	36	26.1	7	53.8	147	16.1
Moderate problems in walking about	1	0.9	6	3.1	13	8.1	16	11.3	20	13.3	27	19.6	3	23.1	86	9.4
Severe problems in walking about	0	0.0	1	0.5	3	1.9	9	6.3	8	5.3	12	8.7	2	15.4	35	3.8
Unable to walk	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0	0	0.0	1	0.1
SELF-CARE																
No problems washing or dressing	110	98.2	188	95.9	156	97.5	128	90.1	138	92.0	122	88.4	9	69.2	851	93.4
Slight problems washing or dressing	1	0.9	6	3.1	2	1.3	6	4.2	5	3.3	10	7.2	3	23.1	33	3.6
Moderate problems washing or dressing	0	0.0	2	1.0	0	0.0	6	4.2	3	2.0	5	3.6	1	7.7	17	1.9
Severe problems washing or dressing	1	0.9	0	0.0	1	0.6	2	1.4	3	2.0	1	0.7	0	0.0	8	0.9
Unable to wash or dress	0	0.0	0	0.0	1	0.6	0	0.0	1	0.7	0	0.0	0	0.0	2	0.2
USUAL ACTIVITES																
No problems doing usual activities	96	85.7	166	84.7	130	81.3	103	72.5	112	74.7	89	64.5	6	46.2	702	77.1
Slight problems doing usual activities	15	13.4	24	12.2	24	15.0	20	14.1	19	12.7	37	26.8	6	46.2	145	15.9
Moderate problems doing usual activities	1	0.9	5	2.6	3	1.9	15	10.6	15	10.0	11	8.0	1	7.7	51	5.6
Severe problems doing usual activities	0	0.0	1	0.5	2	1.3	3	2.1	4	2.7	1	0.7	0	0.0	11	1.2
Unable to do usual activities	0	0.0	0	0.0	1	0.6	1	0.7	0	0.0	0	0.0	0	0.0	2	0.2
PAIN/DISCOMFORT																
No pain or discomfort	69	61.6	108	55.1	86	53.8	75	52.8	77	51.3	57	41.3	1	7.7	473	51.9
Slight pain or discomfort	34	30.4	65	33.2	59	36.9	42	29.6	47	31.3	56	40.6	8	61.5	311	34.1
Moderate pain or discomfort	7	6.3	20	10.2	12	7.5	20	14.1	19	12.7	17	12.3	4	30.8	99	10.9
Severe pain or discomfort	1	0.9	3	1.5	3	1.9	5	3.5	6	4.0	4	2.9	0	0.0	22	2.4
Extreme pain or discomfort	1	0.9	0	0.0	0	0.0	0	0.0	1	0.7	4	2.9	0	0.0	6	0.7
ANXIETY/DEPRESSION																
Not anxious or depressed	60	53.6	105	53.6	96	60.0	82	57.7	100	66.7	89	64.5	9	69.2	541	59.4
Slightly anxious or depressed	36	32.1	57	29.1	44	27.5	37	26.1	29	19.3	36	26.1	4	30.8	243	26.7
Moderately anxious or depressed	10	8.9	21	10.7	13	8.1	19	13.4	17	11.3	9	6.5	0	0.0	89	9.8
Severely anxious or depressed	4	3.6	8	4.1	4	2.5	2	1.4	3	2.0	2	1.4	0	0.0	23	2.5
Extremely anxious or depressed	2	1.8	5	2.6	3	1.9	2	1.4	1	0.7	2	1.4	0	0.0	15	1.6

Totals may not add up to 100% due to rounding.

Appendix 28. PROPr population norms by age group (total) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**141**	**8.6**	**284**	**17.4**	**295**	**18.1**	**281**	**17.2**	**287**	**17.6**	**288**	**17.7**	**55**	**3.4**	**1631**	**100.0**
Physical function																
No problems	108	76.6	210	73.9	215	72.9	179	63.7	149	51.9	119	41.3	13	23.6	993	60.9
Any problems	33	23.4	74	26.1	80	27.1	102	36.3	138	48.1	169	58.7	42	76.4	638	39.1
Depression																
No problems	42	29.8	104	36.6	130	44.1	128	45.6	145	50.5	145	50.3	26	47.3	720	44.1
Any problems	99	70.2	180	63.4	165	55.9	153	54.4	142	49.5	143	49.7	29	52.7	911	55.9
Fatigue																
No problems	25	17.7	55	19.4	68	23.1	69	24.6	84	29.3	100	34.7	12	21.8	413	25.3
Any problems	116	82.3	229	80.6	227	76.9	212	75.4	203	70.7	188	65.3	43	78.2	1218	74.7
Sleep disturbance																
No problems	12	8.5	11	3.9	16	5.4	23	8.2	15	5.2	20	6.9	4	7.3	101	6.2
Any problems	129	91.5	273	96.1	279	94.6	258	91.8	272	94.8	268	93.1	51	92.7	1530	93.8
Social roles																
No problems	61	43.3	111	39.1	133	45.1	120	42.7	103	35.9	93	32.3	14	25.5	635	38.9
Any problems	80	56.7	173	60.9	162	54.9	161	57.3	184	64.1	195	67.7	41	74.5	996	61.1
Pain interference																
No problems	85	60.3	167	58.8	163	55.3	141	50.2	134	46.7	118	41.0	21	38.2	829	50.8
Any problems	56	39.7	117	41.2	132	44.7	140	49.8	153	53.3	170	59.0	34	61.8	802	49.2
Cognitive function																
No problems	31	22.0	85	29.9	106	35.9	119	42.3	117	40.8	122	42.4	16	29.1	596	36.5
Any problems	110	78.0	199	70.1	189	64.1	162	57.7	170	59.2	166	57.6	39	70.9	1035	63.5

Totals may not add up to 100% due to rounding.
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system

Appendix 29. PROPr population norms by age group (males) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**29**	**4.0**	**88**	**12.2**	**135**	**18.8**	**139**	**19.3**	**137**	**19.0**	**150**	**20.8**	**42**	**5.8**	**720**	**100.0**
Physical function																
No problems	26	89.7	72	81.8	110	81.5	100	71.9	76	55.5	73	48.7	13	31.0	470	65.3
Any problems	3	10.3	16	18.2	25	18.5	39	28.1	61	44.5	77	51.3	29	69.0	250	34.7
Depression																
No problems	12	41.4	37	42.0	64	47.4	78	56.1	83	60.6	88	58.7	20	47.6	382	53.1
Any problems	17	58.6	51	58.0	71	52.6	61	43.9	54	39.4	62	41.3	22	52.4	338	46.9
Fatigue																
No problems	9	31.0	24	27.3	40	29.6	39	28.1	46	33.6	58	38.7	12	28.6	228	31.7
Any problems	20	69.0	64	72.7	95	70.4	100	71.9	91	66.4	92	61.3	30	71.4	492	68.3
Sleep disturbance																
No problems	2	6.9	7	8.0	8	5.9	15	10.8	7	5.1	13	8.7	4	9.5	56	7.8
Any problems	27	93.1	81	92.0	127	94.1	124	89.2	130	94.9	137	91.3	38	90.5	664	92.2
Social roles																
No problems	15	51.7	42	47.7	70	51.9	74	53.2	60	43.8	58	38.7	12	28.6	331	46.0
Any problems	14	48.3	46	52.3	65	48.1	65	46.8	77	56.2	92	61.3	30	71.4	389	54.0
Pain interference																
No problems	22	75.9	58	65.9	80	59.3	84	60.4	70	51.1	69	46.0	20	47.6	403	56.0
Any problems	7	24.1	30	34.1	55	40.7	55	39.6	67	48.9	81	54.0	22	52.4	317	44.0
Cognitive function																
No problems	9	31.0	28	31.8	47	34.8	61	43.9	51	37.2	63	42.0	11	26.2	270	37.5
Any problems	20	69.0	60	68.2	88	65.2	78	56.1	86	62.8	87	58.0	31	73.8	450	62.5

Totals may not add up to 100% due to rounding.
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system

Appendix 30. PROPr population norms by age groups (females) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**112**	**12.3**	**196**	**21.5**	**160**	**17.6**	**142**	**15.6**	**150**	**16.5**	**138**	**15.1**	**13**	**1.4**	**911**	**100.0**
Physical function																
No problems	82	73.2	138	70.4	105	65.6	79	55.6	73	48.7	46	33.3	0	0.0	523	57.4
Any problems	30	26.8	58	29.6	55	34.4	63	44.4	77	51.3	92	66.7	13	100.0	388	42.6
Depression																
No problems	30	26.8	67	34.2	66	41.3	50	35.2	62	41.3	57	41.3	6	46.2	338	37.1
Any problems	82	73.2	129	65.8	94	58.8	92	64.8	88	58.7	81	58.7	7	53.8	573	62.9
Fatigue																
No problems	16	14.3	31	15.8	28	17.5	30	21.1	38	25.3	42	30.4	0	0.0	185	20.3
Any problems	96	85.7	165	84.2	132	82.5	112	78.9	112	74.7	96	69.6	13	100.0	726	79.7
Sleep disturbance																
No problems	10	8.9	4	2.0	8	5.0	8	5.6	8	5.3	7	5.1	0	0.0	45	4.9
Any problems	102	91.1	192	98.0	152	95.0	134	94.4	142	94.7	131	94.9	13	100.0	866	95.1
Social roles																
No problems	46	41.1	69	35.2	63	39.4	46	32.4	43	28.7	35	25.4	2	15.4	304	33.4
Any problems	66	58.9	127	64.8	97	60.6	96	67.6	107	71.3	103	74.6	11	84.6	607	66.6
Pain interference																
No problems	63	56.3	109	55.6	83	51.9	57	40.1	64	42.7	49	35.5	1	7.7	426	46.8
Any problems	49	43.8	87	44.4	77	48.1	85	59.9	86	57.3	89	64.5	12	92.3	485	53.2
Cognitive function																
No problems	22	19.6	57	29.1	59	36.9	58	40.8	66	44.0	59	42.8	5	38.5	326	35.8
Any problems	90	80.4	139	70.9	101	63.1	84	59.2	84	56.0	79	57.2	8	61.5	585	64.2

Totals may not add up to 100% due to rounding.
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system

Appendix 31. SF-6D population norms by age group (total) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**141**	**8.6**	**284**	**17.4**	**295**	**18.1**	**281**	**17.2**	**287**	**17.6**	**288**	**17.7**	**55**	**3.4**	**1631**	**100.0**
PHSYICAL FUNCTIONING																
No limitations in vigorous activities	92	65.2	178	62.7	170	57.6	128	45.6	76	26.5	49	17.0	7	12.7	700	42.9
A little limitations in vigorous activities	36	25.5	55	19.4	73	24.7	73	26.0	109	38.0	117	40.6	15	27.3	478	29.3
A little limitations in moderate activities	9	6.4	28	9.9	29	9.8	50	17.8	61	21.3	77	26.7	18	32.7	272	16.7
A lot of limitations in moderate activities	1	0.7	3	1.1	5	1.7	4	1.4	7	2.4	10	3.5	2	3.6	32	2.0
A little limitations in bathing and dressing	2	1.4	13	4.6	15	5.1	21	7.5	25	8.7	32	11.1	12	21.8	120	7.4
A lot of limitations in bathing and dressing	1	0.7	7	2.5	3	1.0	5	1.8	9	3.1	3	1.0	1	1.8	29	1.8
ROLE LIMITATIONS																
You have no problems with your work or other regular daily activities as a result of your physical health or any emotional problems	92	65.2	193	68.0	202	68.5	190	67.6	175	61.0	143	49.7	19	34.5	1014	62.2
You are limited in the kind of work or other activities as a result of your physical health	9	6.4	22	7.7	17	5.8	21	7.5	23	8.0	45	15.6	14	25.5	151	9.3
You accomplish less than you would like as a result of emotional problems	31	22.0	35	12.3	43	14.6	28	10.0	35	12.2	37	12.8	6	10.9	215	13.2
You are limited in the kind of work or other activities as a result of your physical health and accomplish less than you would like as a result of emotional problems	9	6.4	34	12.0	33	11.2	42	14.9	54	18.8	63	21.9	16	29.1	251	15.4
SOCIAL FUNCTIONING																
Your health limits your social activities none of the time	79	56.0	149	52.5	169	57.3	166	59.1	176	61.3	180	62.5	31	56.4	950	58.2
Your health limits your social activities a little of the time	27	19.1	50	17.6	31	10.5	42	14.9	25	8.7	37	12.8	8	14.5	220	13.5
Your health limits your social activities some of the time	21	14.9	55	19.4	59	20.0	48	17.1	47	16.4	39	13.5	10	18.2	279	17.1
Your health limits your social activities most of the time	11	7.8	20	7.0	24	8.1	15	5.3	22	7.7	19	6.6	3	5.5	114	7.0
Your health limits your social activities all of the time	3	2.1	10	3.5	12	4.1	10	3.6	17	5.9	13	4.5	3	5.5	68	4.2

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
PAIN																
You have no pain	62	44.0	104	36.6	111	37.6	90	32.0	86	30.0	86	29.9	14	25.5	553	33.9
You have pain but it does not interfere with your normal work (both outside the home and housework)	20	14.2	52	18.3	50	16.9	47	16.7	56	19.5	47	16.3	8	14.5	280	17.2
You have pain that interferes with your normal work (both outside the home and housework) a little bit	40	28.4	79	27.8	85	28.8	84	29.9	79	27.5	91	31.6	18	32.7	476	29.2
You have pain that interferes with your normal work (both outside the home and housework) moderately	15	10.6	30	10.6	31	10.5	41	14.6	39	13.6	36	12.5	13	23.6	205	12.6
You have pain that interferes with your normal work (both outside the home and housework) quite a bit	3	2.1	14	4.9	10	3.4	17	6.0	18	6.3	25	8.7	1	1.8	88	5.4
You have pain that interferes with your normal work (both outside the home and housework) extremely	1	0.7	5	1.8	8	2.7	2	0.7	9	3.1	3	1.0	1	1.8	29	1.8
MENTAL HEALTH																
You feel tense or downhearted and low none of the time	21	14.9	37	13.0	56	19.0	69	24.6	90	31.4	116	40.3	25	45.5	414	25.4
You feel tense or downhearted and low a little of the time	26	18.4	58	20.4	73	24.7	83	29.5	72	25.1	74	25.7	11	20.0	397	24.3
You feel tense or downhearted and low some of the time	59	41.8	88	31.0	82	27.8	73	26.0	72	25.1	62	21.5	13	23.6	449	27.5
You feel tense or downhearted and low most of the time	32	22.7	81	28.5	73	24.7	49	17.4	41	14.3	28	9.7	6	10.9	310	19.0
You feel tense or downhearted and low all of the time	3	2.1	20	7.0	11	3.7	7	2.5	12	4.2	8	2.8	0	0.0	61	3.7
VITALITY																
You have a lot of energy all of the time	18	12.8	21	7.4	39	13.2	48	17.1	36	12.5	43	14.9	6	10.9	211	12.9
You have a lot of energy most of the time	48	34.0	101	35.6	106	35.9	99	35.2	121	42.2	121	42.0	19	34.5	615	37.7
You have a lot of energy some of the time	49	34.8	93	32.7	91	30.8	93	33.1	70	24.4	73	25.3	20	36.4	489	30.0
You have a lot of energy a little of the time	9	6.4	38	13.4	28	9.5	20	7.1	26	9.1	22	7.6	5	9.1	148	9.1
You have a lot of energy none of the time	17	12.1	31	10.9	31	10.5	21	7.5	34	11.8	29	10.1	5	9.1	168	10.3

Totals may not add up to 100% due to rounding.
SF-6D = Short-Form 6-Dimensions

Appendix 32. SF-6D population norms by age group (males) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**29**	**4.0**	**88**	**12.2**	**135**	**18.8**	**139**	**19.3**	**137**	**19.0**	**150**	**20.8**	**42**	**5.8**	**720**	**100.0**
PHSYICAL FUNCTIONING																
No limitations in vigorous activities	22	75.9	62	70.5	84	62.2	71	51.1	41	29.9	32	21.3	7	16.7	319	44.3
A little limitations in vigorous activities	6	20.7	13	14.8	31	23.0	42	30.2	52	38.0	67	44.7	12	28.6	223	31.0
A little limitations in moderate activities	0	0.0	7	8.0	10	7.4	18	12.9	22	16.1	31	20.7	13	31.0	101	14.0
A lot of limitations in moderate activities	0	0.0	0	0.0	1	0.7	0	0.0	2	1.5	3	2.0	2	4.8	8	1.1
A little limitations in bathing and dressing	0	0.0	4	4.5	9	6.7	7	5.0	14	10.2	16	10.7	7	16.7	57	7.9
A lot of limitations in bathing and dressing	1	3.4	2	2.3	0	0.0	1	0.7	6	4.4	1	0.7	1	2.4	12	1.7
ROLE LIMITATIONS																
You have no problems with your work or other regular daily activities as a result of your physical health or any emotional problems	22	75.9	72	81.8	103	76.3	105	75.5	97	70.8	81	54.0	15	35.7	495	68.8
You are limited in the kind of work or other activities as a result of your physical health	0	0.0	4	4.5	4	3.0	7	5.0	7	5.1	24	16.0	10	23.8	56	7.8
You accomplish less than you would like as a result of emotional problems	4	13.8	7	8.0	13	9.6	12	8.6	13	9.5	22	14.7	6	14.3	77	10.7
You are limited in the kind of work or other activities as a result of your physical health and accomplish less than you would like as a result of emotional problems	3	10.3	5	5.7	15	11.1	15	10.8	20	14.6	23	15.3	11	26.2	92	12.8
SOCIAL FUNCTIONING																
Your health limits your social activities none of the time	15	51.7	55	62.5	84	62.2	87	62.6	89	65.0	103	68.7	26	61.9	459	63.8
Your health limits your social activities a little of the time	9	31.0	13	14.8	15	11.1	19	13.7	13	9.5	16	10.7	6	14.3	91	12.6
Your health limits your social activities some of the time	3	10.3	10	11.4	23	17.0	22	15.8	19	13.9	18	12.0	7	16.7	102	14.2
Your health limits your social activities most of the time	1	3.4	5	5.7	9	6.7	7	5.0	10	7.3	9	6.0	1	2.4	42	5.8
Your health limits your social activities all of the time	1	3.4	5	5.7	4	3.0	4	2.9	6	4.4	4	2.7	2	4.8	26	3.6

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
PAIN																
You have no pain	17	58.6	40	45.5	54	40.0	58	41.7	51	37.2	47	31.3	14	33.3	281	39.0
You have pain but it does not interfere with your normal work (both outside the home and housework)	3	10.3	18	20.5	27	20.0	25	18.0	24	17.5	30	20.0	7	16.7	134	18.6
You have pain that interferes with your normal work (both outside the home and housework) a little bit	7	24.1	22	25.0	39	28.9	36	25.9	37	27.0	48	32.0	14	33.3	203	28.2
You have pain that interferes with your normal work (both outside the home and housework) moderately	2	6.9	6	6.8	11	8.1	18	12.9	16	11.7	13	8.7	6	14.3	72	10.0
You have pain that interferes with your normal work (both outside the home and housework) quite a bit	0	0.0	2	2.3	3	2.2	2	1.4	4	2.9	10	6.7	0	0.0	21	2.9
You have pain that interferes with your normal work (both outside the home and housework) extremely	0	0.0	0	0.0	1	0.7	0	0.0	5	3.6	2	1.3	1	2.4	9	1.3
MENTAL HEALTH																
You feel tense or downhearted and low none of the time	6	20.7	12	13.6	30	22.2	37	26.6	46	33.6	72	48.0	21	50.0	224	31.1
You feel tense or downhearted and low a little of the time	9	31.0	25	28.4	35	25.9	48	34.5	36	26.3	37	24.7	8	19.0	198	27.5
You feel tense or downhearted and low some of the time	7	24.1	21	23.9	40	29.6	30	21.6	39	28.5	29	19.3	8	19.0	174	24.2
You feel tense or downhearted and low most of the time	6	20.7	24	27.3	27	20.0	21	15.1	12	8.8	8	5.3	5	11.9	103	14.3
You feel tense or downhearted and low all of the time	1	3.4	6	6.8	3	2.2	3	2.2	4	2.9	4	2.7	0	0.0	21	2.9
VITALITY																
You have a lot of energy all of the time	7	24.1	10	11.4	20	14.8	27	19.4	17	12.4	23	15.3	5	11.9	109	15.1
You have a lot of energy most of the time	12	41.4	41	46.6	48	35.6	50	36.0	64	46.7	74	49.3	17	40.5	306	42.5
You have a lot of energy some of the time	5	17.2	23	26.1	41	30.4	45	32.4	38	27.7	32	21.3	13	31.0	197	27.4
You have a lot of energy a little of the time	2	6.9	8	9.1	14	10.4	9	6.5	9	6.6	11	7.3	5	11.9	58	8.1
You have a lot of energy none of the time	3	10.3	6	6.8	12	8.9	8	5.8	9	6.6	10	6.7	2	4.8	50	6.9

Totals may not add up to 100% due to rounding.
SF-6D = Short-Form 6-Dimensions

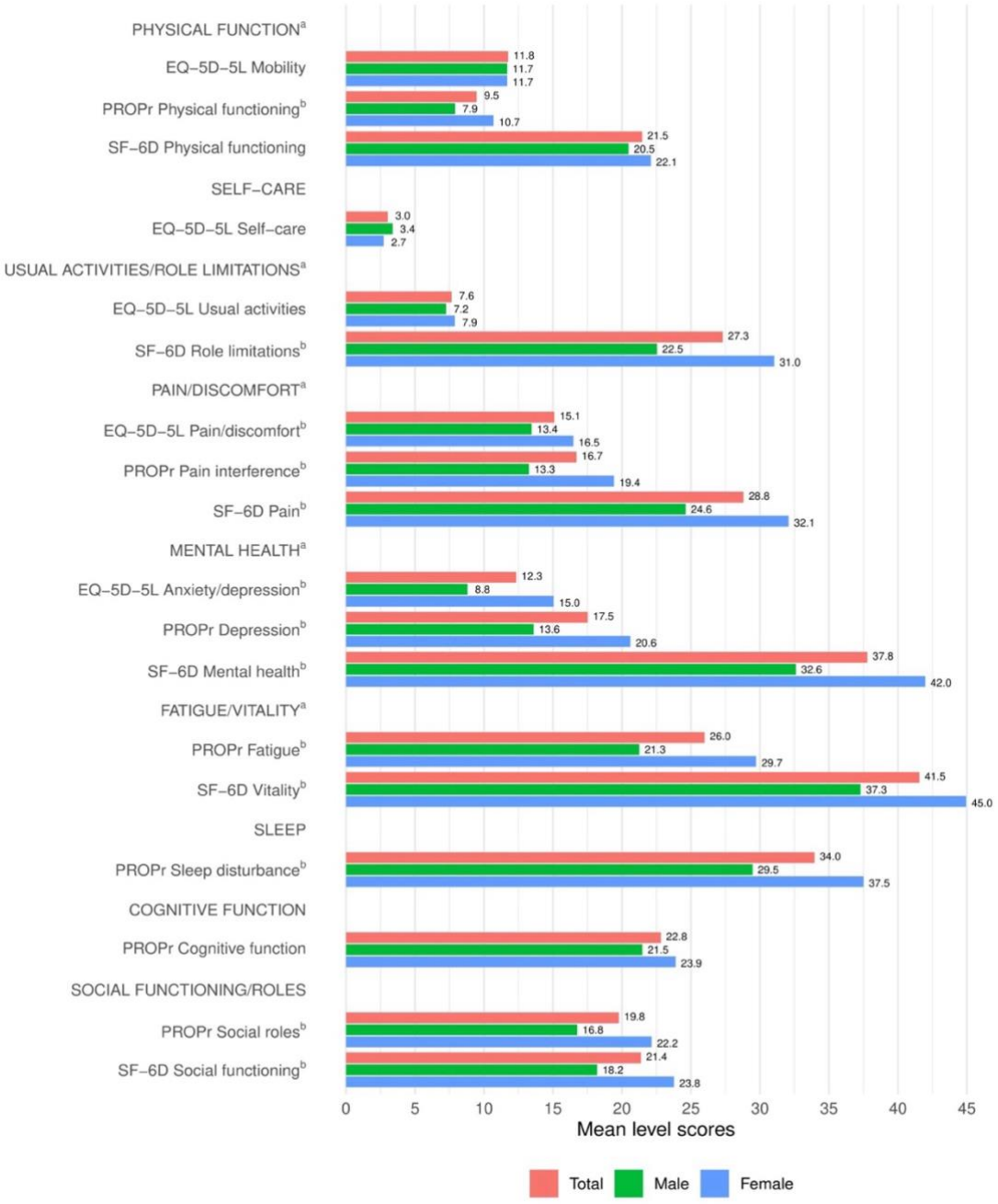
Appendix 33. SF-6D population norms by age group (females) (135)

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	**112**	**12.3**	**196**	**21.5**	**160**	**17.6**	**142**	**15.6**	**150**	**16.5**	**138**	**15.1**	**13**	**1.4**	**911**	**100.0**
PHSYICAL FUNCTIONING																
No limitations in vigorous activities	70	62.5	116	59.2	86	53.8	57	40.1	35	23.3	17	12.3	0	0.0	381	41.8
A little limitations in vigorous activities	30	26.8	42	21.4	42	26.3	31	21.8	57	38.0	50	36.2	3	23.1	255	28.0
A little limitations in moderate activities	9	8.0	21	10.7	19	11.9	32	22.5	39	26.0	46	33.3	5	38.5	171	18.8
A lot of limitations in moderate activities	1	0.9	3	1.5	4	2.5	4	2.8	5	3.3	7	5.1	0	0.0	24	2.6
A little limitations in bathing and dressing	2	1.8	9	4.6	6	3.8	14	9.9	11	7.3	16	11.6	5	38.5	63	6.9
A lot of limitations in bathing and dressing	0	0.0	5	2.6	3	1.9	4	2.8	3	2.0	2	1.4	0	0.0	17	1.9
ROLE LIMITATIONS																
You have no problems with your work or other regular daily activities as a result of your physical health or any emotional problems	70	62.5	121	61.7	99	61.9	85	59.9	78	52.0	62	44.9	4	30.8	519	57.0
You are limited in the kind of work or other activities as a result of your physical health	9	8.0	18	9.2	13	8.1	14	9.9	16	10.7	21	15.2	4	30.8	95	10.4
You accomplish less than you would like as a result of emotional problems	27	24.1	28	14.3	30	18.8	16	11.3	22	14.7	15	10.9	0	0.0	138	15.1
You are limited in the kind of work or other activities as a result of your physical health and accomplish less than you would like as a result of emotional problems	6	5.4	29	14.8	18	11.3	27	19.0	34	22.7	40	29.0	5	38.5	159	17.5
SOCIAL FUNCTIONING																
Your health limits your social activities none of the time	64	57.1	94	48.0	85	53.1	79	55.6	87	58.0	77	55.8	5	38.5	491	53.9
Your health limits your social activities a little of the time	18	16.1	37	18.9	16	10.0	23	16.2	12	8.0	21	15.2	2	15.4	129	14.2
Your health limits your social activities some of the time	18	16.1	45	23.0	36	22.5	26	18.3	28	18.7	21	15.2	3	23.1	177	19.4
Your health limits your social activities most of the time	10	8.9	15	7.7	15	9.4	8	5.6	12	8.0	10	7.2	2	15.4	72	7.9
Your health limits your social activities all of the time	2	1.8	5	2.6	8	5.0	6	4.2	11	7.3	9	6.5	1	7.7	42	4.6

	18-24		25-34		35-44		45-54		55-64		65-74		75+		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
PAIN																
You have no pain	45	40.2	64	32.7	57	35.6	32	22.5	35	23.3	39	28.3	0	0.0	272	29.9
You have pain but it does not interfere with your normal work (both outside the home and housework)	17	15.2	34	17.3	23	14.4	22	15.5	32	21.3	17	12.3	1	7.7	146	16.0
You have pain that interferes with your normal work (both outside the home and housework) a little bit	33	29.5	57	29.1	46	28.8	48	33.8	42	28.0	43	31.2	4	30.8	273	30.0
You have pain that interferes with your normal work (both outside the home and housework) moderately	13	11.6	24	12.2	20	12.5	23	16.2	23	15.3	23	16.7	7	53.8	133	14.6
You have pain that interferes with your normal work (both outside the home and housework) quite a bit	3	2.7	12	6.1	7	4.4	15	10.6	14	9.3	15	10.9	1	7.7	67	7.4
You have pain that interferes with your normal work (both outside the home and housework) extremely	1	0.9	5	2.6	7	4.4	2	1.4	4	2.7	1	0.7	0	0.0	20	2.2
MENTAL HEALTH																
You feel tense or downhearted and low none of the time	15	13.4	25	12.8	26	16.3	32	22.5	44	29.3	44	31.9	4	30.8	190	20.9
You feel tense or downhearted and low a little of the time	17	15.2	33	16.8	38	23.8	35	24.6	36	24.0	37	26.8	3	23.1	199	21.8
You feel tense or downhearted and low some of the time	52	46.4	67	34.2	42	26.3	43	30.3	33	22.0	33	23.9	5	38.5	275	30.2
You feel tense or downhearted and low most of the time	26	23.2	57	29.1	46	28.8	28	19.7	29	19.3	20	14.5	1	7.7	207	22.7
You feel tense or downhearted and low all of the time	2	1.8	14	7.1	8	5.0	4	2.8	8	5.3	4	2.9	0	0.0	40	4.4
VITALITY																
You have a lot of energy all of the time	11	9.8	11	5.6	19	11.9	21	14.8	19	12.7	20	14.5	1	7.7	102	11.2
You have a lot of energy most of the time	36	32.1	60	30.6	58	36.3	49	34.5	57	38.0	47	34.1	2	15.4	309	33.9
You have a lot of energy some of the time	44	39.3	70	35.7	50	31.3	48	33.8	32	21.3	41	29.7	7	53.8	292	32.1
You have a lot of energy a little of the time	7	6.3	30	15.3	14	8.8	11	7.7	17	11.3	11	8.0	0	0.0	90	9.9
You have a lot of energy none of the time	14	12.5	25	12.8	19	11.9	13	9.2	25	16.7	19	13.8	3	23.1	118	13.0

Totals may not add up to 100% due to rounding.
SF-6D = Short-Form 6-Dimensions

Appendix 34. Mean level scores in health domains of three preference-accompanied measures by genders (135)

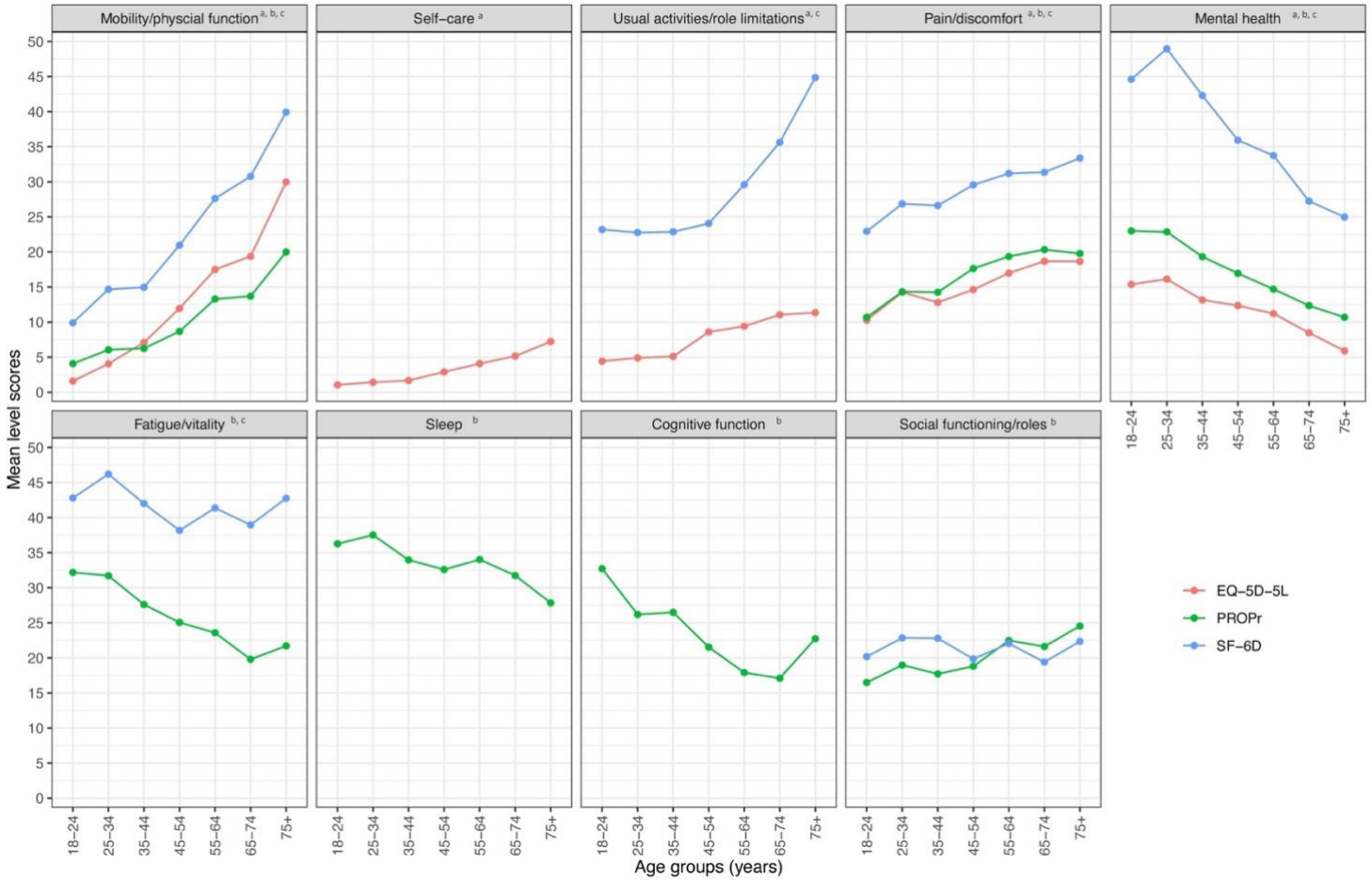


Student's t-test or analysis of variance was performed where a health domain was covered by more than one instrument. All corresponding domain groups where there was a significant difference between the mean level score of the domain responses (p-value<0.05) are marked with [a].

Student's t-test or analysis of variance was performed to assess the difference between genders in each health domains of all three instruments. All domains where there was a significant difference between the female and male subsample (p-value<0.05) are marked with [b].

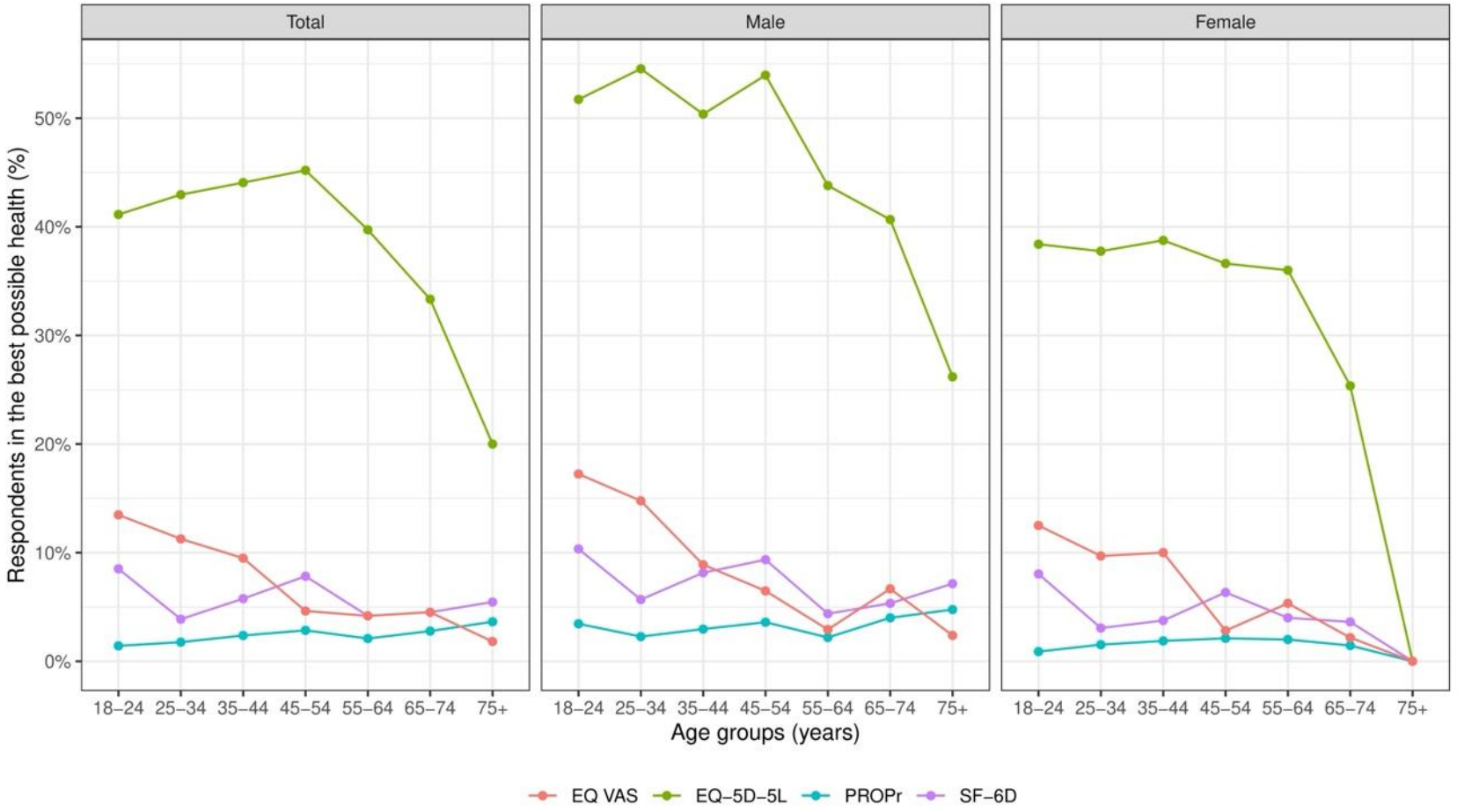
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions

Appendix 35. Mean level scores in health domains of three preference-accompanied measures by age group (135)



Student's t-test or analysis of variance was performed to assess the difference between age groups. All domains where p-values were <0.05 are marked with [a] for EQ-5D-5L, [b] for PROPr and [c] for SF-6D.
PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions

Appendix 36. Proportion of respondents in the best possible health by age and gender groups (135)



PROPr = Patient-Reported Outcomes Measurement Information System-Preference scoring system; SF-6D = Short-Form 6-Dimensions; EQ VAS = EuroQol Visual Analogue Scale