SEMMELWEIS EGYETEM

DOKTORI ISKOLA

Ph.D. értekezések

3610.

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Measurement of health-related quality of life in patients undergoing minimally invasive cosmetic procedures

PhD thesis

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Budapest
2026

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List of abbreviations

BFNE-S – Brief Fear of Negative Evaluation Scale – Straightforward Items

BMI – Body mass index

BoNT-A – Botulinum neurotoxin type A

BoNT-B – Botulinum neurotoxin type B

CFA – Confirmatory factor analysis

CFI – Comparative Fit Index

CO_2 – Carbon dioxide

COPD – Chronic obstructive pulmonary disease

COSMIN – Consensus-based Standards for the Selection of Health Measurement Instruments

DLQI – Dermatology Life Quality Index

DLQI-R – Dermatology Life Quality Index-Relevant

EQ VAS – EuroQol Visual Analogue Scale

FDA – Food and Drug Administration

FLO-11 – Facial Line Outcomes

FLSQ – Facial Line Satisfaction Questionnaire

FTS – Facial Line Treatment Satisfaction

HA – Hyaluronic acid

HRQoL – Health-related quality of life

HUI – Health Utilities Index

IQR – Interquartile range

ISPOR – International Society for Pharmacoeconomics and Outcomes Research

KMO – Kaiser–Meyer–Olkin

LSS – Level sum score

MICPs – Minimally invasive cosmetic procedures

PCA – Principal component analysis

PLLA – Poly-L-lactic acid

PROMs – Patient-reported outcome measures

PRP – Platelet-rich plasma

QALY – Quality-adjusted life year

QoL – Quality of life

QWB – Quality of Well-Being

RE – Relative efficiency

RMSEA – Root mean square error of approximation

RSES – Rosenberg Self-Esteem Scale

SD – Standard deviation

SF-6D – Short Form 6 Dimensions

SPA – Self-Perception of Age

SRMR – Standardized Root Mean Square Residual

VAS – Visual Analogue Scale

WHO – World Health Organization

WHOQOL-BREF – World Health Organization Quality of Life – BREF

1 Introduction

Interest in minimally invasive cosmetic procedures (MICPs) has steadily increased in recent years. According to the 2024 annual statistics report from the American Society of Plastic Surgeons, approximately 28 million MICPs were performed, representing a 1.5% increase compared with 2023 (1). MICPs include techniques such as injectable treatments and skin resurfacing procedures to restore a youthful appearance (2). Unlike cosmetic surgical interventions, these office-based interventions are generally associated with lower risks and shorter recovery times (3). The most popular MICPs are neuromodulator injections and soft-tissue augmentation with fillers. Most patients who undergo MICPs are women aged 40 to 55 years (1).

Patients have various motivations for undergoing MICPs. Apart from enhancing physical appearance by seeking a younger or more refreshed look, these motivations often extend beyond the desire for physical attractiveness. Motives related to mental and/or emotional well-being, including feeling happier, celebrating and rewarding oneself, are also commonly reported (4,5).

Several studies have demonstrated that MICPs improve health-related quality of life (HRQoL). Reported benefits include reduced body image dissatisfaction, improved satisfaction with facial appearance and psychosocial well-being (6–10). However, most studies focused on psychosocial well-being and self-perception, with limited use of measures assessing mental health outcomes, such as anxiety and depression (11). Although numerous studies suggest that individuals pursue MICPs to enhance social and psychosocial well-being, there is limited evidence to quantify their effects on these outcomes. Improvements in HRQoL following MICPs can be measured using patient-reported outcome measures (PROMs) (7).

Assessment of HRQoL is important not only for monitoring patients' clinical status but also for evaluating perceived treatment benefits, which can be used to demonstrate the value of these procedures and inform economic evaluations. This is particularly relevant because cosmetic procedures are generally not covered by health insurance unless considered medically necessary, such as for reconstructive indications (12).

This thesis seeks to investigate HRQoL in patients undergoing MICPs in Hungary. The first chapter describes the MICPs included in the thesis and provides background on

HRQoL assessment in this context. The subsequent chapters present the findings of studies conducted by our research team in Hungary in 2023. An online cross-sectional questionnaire survey was carried out between February and December 2023 among individuals planning or undergoing MICPs. The first study (bolt-on study) examined the psychometric properties of the EQ-5D-5L, the most widely used generic preference-based HRQoL measure, and its bolt-ons in individuals planning to undergo or having undergone MICPs. The second study (FACE-Q study) involved the translation, cultural adaptation and validation of selected HRQoL scales from the FACE-Q, a widely used PROM.

1.1 Minimally invasive cosmetic procedures included in this thesis

MICPs comprise a broad range of non-surgical interventions designed to improve facial appearance. These procedures include injectable treatments, such as botulinum toxin and dermal fillers, as well as skin resurfacing techniques using lasers and other energy-based devices (13). Although MICPs are most commonly performed on the face, they can also be used to treat other areas of the body (14).

1.1.1 Dermal fillers

Dermal fillers are used to enhance facial appearance by restoring volume and shaping contours in line with commonly accepted aesthetic ideals. Specific proportions and curves are associated with youth, and volumetric augmentation helps recreate these characteristics in the aging face (15). Dermal fillers are injected into the dermis or subcutaneous tissue using either needles or cannulas. The number of injectable dermal fillers available on the market continues to increase each year. Hyaluronic acid (HA) fillers are the most commonly used, although other filler types, including calcium hydroxylapatite, poly-L-lactic acid (PLLA) and collagen-based fillers, are also available (16). HA fillers are widely used because they provide natural-looking results, have a favorable safety profile and are associated with minimal downtime (17). A unique advantage of HA fillers is the availability of an effective reversal agent, hyaluronidase, which allows enzymatic degradation of the filler. Dermal fillers are generally well-tolerated, although mild and transient adverse events, such as swelling, bruising, and contour irregularities, may occur, as well as infections. With the increasing use of dermal fillers, however, more serious complications, including cutaneous vascular complications (18) and vision loss (19), have also been reported.

1.1.2 Botulinum toxin injections

Botulinum toxin is a protease exotoxin produced by Clostridium botulinum (20). Seven serotypes of botulinum neurotoxin (A–G) have been identified, of which types A (BoNT-A) and B (BoNT-B) are commercially available for medical use. Botulinum neurotoxins cause temporary flaccid paralysis by inhibiting presynaptic acetylcholine release at cholinergic nerve endings in the peripheral nervous system, thereby preventing neuromuscular transmission and reducing motor end-plate potentials within hours of injection. As a result, muscle or glandular activity is diminished (21). The clinical effects of botulinum toxin are temporary and dose-dependent, and may be modulated by adjusting the dosage and frequency of administration (22). The duration of the effect typically ranges from 3 to 4 months and is influenced by factors such as dose, concentration, injection technique and individual patient response (20). Botulinum toxin injections are widely used to treat facial rhytides, contour the lower face, calves and neckline and manage focal hyperhidrosis of the axillae, forehead, hands and scalp (21). The majority of adverse events related to botulinum toxin injections are mild and temporary, such as hypersensitivity reactions (type I and IV hypersensitivity reactions, pseudoallergy), injection site reactions (local edema, erythema, bruising, pain) and muscle-related complications (eyebrow ptosis, eyebrow shape abnormalities, asymmetry and contour abnormalities of the lip) (23).

1.1.3 Mesotherapy

Mesotherapy techniques involve injecting therapeutic agents into the dermal layer of the skin with thin needles to a depth of 2–4 mm, thereby bypassing the barrier that topical agents encounter (24). A review article by Kandhari et al. (25) summarized the ingredients of mesotherapy products used in cosmetic dermatology. Mesotherapy formulations for skin rejuvenation may include non-cross-linked HA, dimethylaminoethanol, silicium, dipeptide carnosine, and peptides, as well as glutathione and ascorbic acid-based solutions combined with kojic acid, glycolic acid, pyruvic acid, and azelaic acid to improve skin brightness and reduce superficial pigmentary abnormalities. Phosphatidylcholine and deoxycholic acid are commonly used for ablative lipolysis through detergent-mediated adipocyte destruction. The ‘mesobotox’ technique involves superficial intradermal delivery of botulinum toxin to target superficial facial muscle

fibers while preserving deeper muscle function, thereby improving skin texture by reducing sweat and sebaceous gland activity. Mesotherapy injections containing minoxidil, finasteride, dutasteride and biotin are also used to treat alopecia (25). Common adverse effects include bruising, edema and infection, whereas less frequent complications include granulomatous foreign-body reactions, dermal microabscesses, panniculitis, extensive fat necrosis and aggravation of preexisting dermatological conditions through the Koebner phenomenon (26).

1.1.4 Monofilament thread therapy and COG thread lifting

Thread lifting improves sagging of the midface and jawline through the subcutaneous placement of specialized threads that provide mechanical soft-tissue support, without incisions and with a shorter recovery time than surgical facelifts (27). Thread-lift materials are typically biocompatible, absorbable polymers such as polydioxanone, PLLA, and polycaprolactone, which degrade over time while providing mechanical support and promoting collagen formation (28). Monofilament thread contouring primarily improves skin quality through collagen stimulation, whereas COG thread lifting provides mechanical soft-tissue elevation using barbed sutures for immediate lifting effects (28). Related complications include swelling, hematoma, skin dimpling, visible or palpable threads, thread extrusion, contour irregularities and infection (29).

1.1.5 Facial laser resurfacing

Laser resurfacing can improve the appearance of rhytides, skin texture and various types of scars. Laser resurfacing techniques vary by depth and pattern of tissue injury. Ablative lasers vaporize epidermal and dermal tissue, making them more aggressive than nonablative lasers, which induce dermal remodeling while leaving the epidermis intact (30). Additionally, lasers may be delivered in nonfractionated or fractionated modes, with the latter targeting only a portion of the treated skin surface (31). Commonly used lasers for skin resurfacing include carbon dioxide (CO_2) and erbium-doped yttrium aluminum garnet lasers (32). Common adverse events include transient or prolonged erythema, edema, serous drainage, acneiform eruptions, delayed or permanent hypo- or hyperpigmentation, scarring and infections (33).

1.1.6 Medical-grade chemical peelings

Chemical peeling is a procedure used for cosmetic skin improvement and for the treatment of selected dermatologic disorders. A chemical exfoliating agent is applied to the skin to induce controlled epidermal or dermal injury (34). Superficial peels, confined to the epidermis, are used for mild acne and melasma, whereas medium-depth peels extend into the papillary dermis and are indicated for actinic keratoses, lentigines, dyschromia and static rhytides. Common agents include glycolic acid, salicylic acid, Jessner solution, retinoic acid, lactic acid, mandelic acid, pyruvic acid and trichloroacetic acid (10%–35%). Medium-depth peels typically combine trichloroacetic acid with glycolic acid, Jessner solution, or phenol (35,36). Adverse events associated with chemical peels include edema, pain, pruritus, folliculitis, acneiform eruptions, ecchymosis, persistent erythema, infection, telangiectasia, hypo- or hyperpigmentation, scarring and demarcation lines (37).

1.1.7 Platelet-rich plasma therapy (PRP)

PRP is an autologous plasma fraction with platelet concentrations above baseline, enriched with clotting factors, growth factors, cytokines and other bioactive proteins. It is prepared by anticoagulating whole blood followed by centrifugation to obtain either pure or leukocyte-rich PRP (38). PRP promotes tissue regeneration by releasing growth factors that stimulate angiogenesis, fibroblast proliferation and collagen synthesis (39). Intradermal PRP injections improve photoaging, fine lines, melasma, acne scars, and increase hair density in androgenetic alopecia (40). PRP has generally been reported to be safe, with few adverse effects (41). However, rare cases of blindness associated with iatrogenic occlusion of the ophthalmic artery have been described (42).

1.2 HRQoL

HRQoL has become an important outcome measure in healthcare, providing insight into the physical, psychological and social impacts of health conditions. It is widely applied in medical and health research across diverse populations and settings (43).

The World Health Organization (WHO) defined health as '*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'* (44). The definition includes physical, mental and social dimensions, emphasizing that health is more than the absence of disease (45).

The WHO defines quality of life (QoL) as an '*individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns'* (46). QoL is multidimensional and can be described across five key domains: physical well-being, material well-being, social well-being, emotional well-being, and personal development and activity (47).

HRQoL refers specifically to the aspects of QoL that are influenced by health. The term originated in the health status measurement literature. Kaplan and Bush (48) used HRQoL in their discussion of quality-adjusted life years (QALYs) as an indicator of the value of a year of life in optimal health. HRQoL lacks a universally accepted definition, and multiple definitions have been proposed in the literature (45). These include HRQoL as functioning and well-being, HRQoL as the health aspects of QoL, and HRQoL as aspects of QoL that are affected by health. Other authors defined HRQoL as the utility associated with health (as measured by valuing health states described by standardized instruments) (45).

1.3 Measurement of HRQoL

PROMs are standardized questionnaires used to assess health outcomes from the patient's perspective, including symptoms, functional status and HRQoL (49). These measures complement clinical and physiological assessments and may, in certain settings, replace them (50,51). PROMs were initially developed to complement clinical outcomes in studies evaluating new interventions. Their use has since expanded to clinical practice, where they are used alongside traditional outcome indicators (e.g., mortality, prevalence/incidence) (52). PROMs are not limited to assessing HRQoL; they can also be used to measure symptoms, disease severity, well-being, work productivity, and other outcomes reported directly by patients (53).

HRQoL measures are self- or interviewer-administered questionnaires used to assess HRQoL (54). They are widely used in healthcare and research for assessing individuals' health status. They provide valuable information on treatment effectiveness, disease burden and population health. They are commonly classified as either generic or condition-specific instruments and as preference-based or non-preference-based measures (55).

The difference between preference-based and non-preference-based measures lies in their ability to generate utility values. Only preference-based instruments allow calculation of utility values and can therefore be used in economic evaluations (56). Most national health economic evaluation guidelines recommend using QALYs as health outcome measures, with HRQoL valuation most commonly based on generic health instruments (57). Generic preference-based measures are standardized questionnaires that comprise a descriptive health state classification system (i.e., a descriptive system) and corresponding preference weights. Patient responses define a unique health state, to which a utility value is assigned using an established tariff or value set (56). Common generic preference-based measures include the EQ-5D, the Short Form–6 Dimensions (SF-6D), the Health Utilities Index (HUI), and the Quality of Well-Being (QWB) questionnaire (57).

A wide range of non-preference-based instruments exists, including generic, dermatology-specific, and disease-specific measures. Generic instruments are intended to assess HRQoL across diverse populations, including both healthy individuals and those with chronic conditions. While they may lack sensitivity in detecting changes in HRQoL in specific conditions, they are used to compare HRQoL across populations with different conditions (51). Disease-specific instruments capture dimensions directly related to a patient's condition and are particularly responsive to changes in HRQoL (58).

1.3.1 EQ-5D

The EQ-5D is the most widely used generic preference-based HRQoL measure for estimating QALYs in cost-utility analyses of health interventions, as recommended in various national health technology assessment guidelines (59,60). The EQ-5D is a recommended method for measuring health utilities in the Hungarian guidelines for health economic evaluations (61).

The EQ-5D comprises two components: a descriptive system and a 0–100 visual analogue scale (EQ VAS). The EQ VAS is a vertical scale ranging from 0 (the worst health you can imagine) to 100 (the best health you can imagine). The descriptive system has two versions designed for adults: the EQ-5D-3L and the EQ-5D-5L, both of which measure health across five dimensions, including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. In the EQ-5D-3L, each dimension is rated on

three levels: no problems, some/moderate problems, and confined to bed/unable to/extreme problems. Responses across the three levels of the five EQ-5D dimensions define 243 distinct health states, also referred to as health profiles (62). The EQ-5D-5L is rated on five levels of severity: 1 = no problems, 2 = slight problems, 3 = moderate problems, 4 = severe problems, and 5 = extreme problems/unable to. The descriptive system can represent up to 3,125 (5^5) distinct health profiles (63). The EQ-5D-5L has a Hungarian value set (64). Several studies have shown that the EQ-5D-5L (hereafter EQ-5D) exhibits better measurement properties than the EQ-5D-3L in both general population samples and patient populations, including those with malignant diseases, chronic liver disease, diabetes, osteoarthritis, psoriasis and stroke (65).

Although the EQ-5D has demonstrated strong psychometric properties in diverse populations (66), the instrument may not cover all important dimensions of HRQoL in specific patient groups or clinical settings (67). To address this limitation, additional dimensions ('bolt-ons') can be added to the instrument to improve its sensitivity (68). A recent systematic review identified 26 bolt-ons, with the most frequently mentioned or tested bolt-ons being cognition, vision, relationships, sleep, hearing, energy and tiredness (69). In patients with psoriasis, two bolt-ons were developed (skin irritation and self-confidence) (70). Adding skin irritation and self-confidence bolt-ons to the EQ-5D enhanced its psychometric performance in chronic dermatological diseases, including psoriasis (70–72), atopic dermatitis (73), and rare genetic skin disorders (74,75).

1.3.2 HRQoL measures in cosmetic dermatology

Understanding the patient's perspective is particularly important in cosmetic dermatology, where treatment goals are centered on patients' perceptions of their appearance (76). Few PROMs have been validated and studied in patients undergoing cosmetic procedures (77). Additionally, a minority of these measures assess aspects of HRQoL, such as psychosocial impact (78). A recent review identified seven validated questionnaires as the most relevant and most frequently used for facial aesthetic treatment studies: Facial Line Satisfaction Questionnaire (FLSQ), Facial Lines Outcomes (FLO-11), Facial Lines Treatment Satisfaction (FTS), Self-Perception of Age (SPA), Dermatology Life Quality Index (DLQI), Skindex, and FACE-Q Aesthetics (79).

The FLSQ is an 11-item questionnaire (baseline) and a 13-item questionnaire (follow-up) used in adults with upper facial lines, assessing domains such as treatment expectations, impact and satisfaction (80).

The FLO-11 was developed to assess the impact of upper facial lines on patients' lives, including psychosocial domains (e.g., feeling unattractive, bothered by facial lines) (81).

The FTS measures patient satisfaction with facial line treatment, comprising 11 items evaluating treatment outcomes and 3 assessing satisfaction (82).

The SPA is a single-item measure that reflects the patient's perception of how old they look at baseline and after the procedure (83).

The DLQI was the first dermatology-specific instrument developed to measure HRQoL (84). The DLQI is the most widely used instrument for measuring HRQoL in dermatology and has been translated into more than 130 languages and applied across more than 60 skin conditions worldwide (85). The DLQI assesses the impact of skin disease on different aspects of patients' lives, including daily activities, leisure, work or school, personal relationships and treatment. The DLQI consists of 10 items, eight of which include a 'not relevant' response option. Each item is scored from 0 ('not at all') to 3 ('very much'), resulting in a total score ranging from 0 to 30, with higher scores indicating greater impairment in HRQoL (84). DLQI-Relevant (DLQI-R) is a modified scoring method developed by Rencz et al. in 2018 that adjusts the DLQI total score for the number of 'not relevant' responses. 'Not relevant' responses are important to consider, as scoring them as 'not at all' may underestimate the disease's impact on patients' HRQoL. DLQI-R has been shown to improve the discriminatory power of the DLQI and may help to more accurately quantify patients' HRQoL (86,87).

Skindex-29 (88) is a dermatology-specific instrument designed to assess HRQoL. It consists of three domains—symptoms (7 items), emotions (10 items), and functioning (12 items). Responses are converted to a 0–100 scale, where higher scores indicate greater impact, and domain scores are calculated as the mean of the items within each domain. Shortened versions of the instrument include Skindex-17 (89), Skindex-16 (88) and Skindex-mini (90).

1.3.3 FACE-Q Aesthetics scales

The FACE-Q™ Aesthetics is a PROM developed by Klassen et al. in 2010 for individuals undergoing surgical and nonsurgical aesthetic facial procedures (76). The instrument was designed in accordance with established guidelines for instrument development (91,92), covering three phases: item generation, scale formation and psychometric testing. A conceptual framework and item pool were created based on qualitative patient interviews, expert input and literature review (76). The item pool was pilot tested, followed by field testing in a large patient sample to identify the best-performing items. The final measure underwent psychometric evaluation to assess reliability, validity and responsiveness (93).

The FACE-Q Aesthetics covers four domains: facial appearance (27 scales), HRQoL (10 scales), natural (3 scales) and adverse effects (6 checklists) (94). Many of its scales and checklists have undergone psychometric testing (93,95–102) and are widely used in clinical practice, research and clinical trials (103–105). Certain components have also been validated in non-aesthetic contexts, such as facial trauma surgery or procedures for functional problems due to malignancies (106,107). In 2022, the US Food and Drug Administration (FDA) recognized several FACE-Q Aesthetics scales as qualified medical device development tools, underscoring their clinical and regulatory significance (94).

The modular structure of the FACE-Q Aesthetics, which comprises multiple scales, enables researchers and clinicians to address clinical questions related to both surgical and nonsurgical facial interventions. Moreover, its standardized scoring system is simple to use and allows for comparisons across studies (104). Since its introduction, the use of the FACE-Q has increased, with a systematic review identifying 114 studies that used the FACE-Q Aesthetics as an outcome measure (108).

1.4 Measurement properties of HRQoL measures

HRQoL instruments should undergo psychometric evaluation before being used in research and clinical practice. This includes assessing several measurement properties, including validity, which refers to the degree to which a questionnaire measures the construct it is intended to assess (109). The key measurement properties of HRQoL instruments are outlined in Table 1 (110). The Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) initiative has further refined

the terminology and methodological standards for evaluating the measurement properties of PROMs (111,112).

Table 1. Measurement properties of health status questionnaires, adapted from Terwee et al. (110)

Property	**Definition**
Content validity	Refers to the extent to which the items of a questionnaire reflect the intended construct of interest (54).
a. Comprehensiveness	Refers to whether all key aspects of the outcome are covered by the instrument (113).
b. Comprehensibility	Refers to whether the instrument's content is understood by the target population as intended by its developers (113).
c. Relevance	Refers to whether the instrument's content is relevant for the intended outcome, target population and context of use (113).
Internal consistency	Refers to the degree to which the items of a questionnaire or its subscale/domain are interrelated, indicating that they assess the same underlying construct.
Criterion validity	Refers to the extent to which scores on an instrument correspond to a gold standard.
Construct validity	Refers to the extent to which scores on an instrument are consistent with other measures in ways that match theoretical expectations about the construct being measured (114).
Reproducibility	Refers to the extent to which repeated measurements in stable individuals yield similar results.
a. Agreement	Refers to the extent to which repeated assessments produce similar scores (absolute measurement error).

Property	Definition
b. Reliability	Refers to the extent to which an instrument can differentiate between individuals despite the presence of measurement error (relative measurement error).
Responsiveness	Refers to the ability of a questionnaire to detect changes over time, even when they are small (115).
Floor or ceiling effects	Occur when more than 15% of respondents achieve the lowest or highest possible score, limiting the instrument's ability to discriminate between individuals at the lower or upper end of the scale (116).
Interpretability	Refers to the extent to which qualitative meaning can be assigned to quantitative scores (117).

2 Objectives

The aim of this thesis was to evaluate the psychometric properties of HRQoL instruments in individuals planning or undergoing MICPs. The detailed aims of the studies are presented below.

2.1 Psychometric performance of adding bolt-ons to the EQ-5D-5L in populations undergoing minimally invasive cosmetic procedures

The aims of this study were:

1) To evaluate the psychometric properties of the EQ-5D-5L in individuals planning or undergoing MICPs.

2) To evaluate the psychometric properties of potentially relevant EQ-5D-5L bolt-ons in this population.

2.2 Psychometric properties of four FACE-Q Aesthetics scales in patients planning and undergoing minimally invasive facial cosmetic procedures

The aims of this study were:

1) To translate and culturally adapt four existing scales from the FACE-Q Aesthetics HRQoL module into Hungarian.

2) To evaluate the psychometric properties of the four scales.

3 Methods

This chapter relies on the findings of the two publications of the candidate:

1. **Müller EM**, Nikl A, Krebs M, Holló P, Brodszky V, Kemény LV, Rencz F. Psychometric benefits of adding bolt-ons to the EQ-5D-5L in populations undergoing minimally invasive cosmetic procedures. Eur J Health Econ. 2025;26:1233–1247. doi:10.1007/s10198-025-01772-9.

2. **Müller EM**, Nikl A, Krebs M, Szabó Á, Holló P, Brodszky V, Rencz F, Kemény LV. Psychometric properties of four FACE-Q Aesthetics scales in patients planning and undergoing minimally invasive facial cosmetic procedures. Qual Life Res. 2026;35:201. doi:10.1007/s11136-026-04313-w.

All HRQoL measures used in this thesis were administered in Hungarian. Ethical approval for both studies was obtained from the Semmelweis University Regional and Institutional Committee of Science and Research Ethics under reference no. SE/RKEB: 15/2023.

3.1 Bolt-on study methods

3.1.1 Study design and patient population

An online cross-sectional questionnaire survey was conducted in Hungary between February and December 2023. To be eligible for the study, individuals were required to i) have undergone MICP(s) (‘undergone’ group) in the last two months or to plan to undergo such procedure(s) (‘planning’ group) in the next two months (e.g., soft tissue augmentation, botulinum toxin treatments, mesotherapy, monofilament thread therapy, cog thread lifting, facial laser resurfacing, medical grade peeling and platelet-rich plasma treatment); ii) be 18 years or older; iii) be able to read and understand the questions in Hungarian; and iv) provide informed consent. Patients were recruited via social media groups and personal contacts of the research team. These social media groups provide a platform for individuals who want to share their experiences about cosmetic surgery and MICPs. We shared the questionnaire in six groups (with member counts ranging from 1000 to 60,000). Moreover, the survey was shared on the social media platform of a large Hungarian women’s lifestyle magazine.

The survey consisted of four parts. The first part included questions about the respondent's general health status and HRQoL. This section contained a five-point general health scale (excellent-to-poor), the EQ-5D-5L descriptive system, the EQ VAS, and the skin irritation and self-confidence bolt-ons. The second part collected information regarding the completed or planned aesthetic treatments, including the motivations for seeking MICPs and the procedure's type, date, and localization. To explore motivations for seeking MICPs, participants were asked to rate their agreement with nine potential reasons for undergoing the procedure on a scale from 1 ('completely disagree') to 10 ('completely agree'), using the same statements as those in a previous study (118). The only difference between the questionnaires for individuals planning MICPs versus those who had already undergone them was that the latter group received the FACE-Q Early Life Impact of Treatment (hereafter: Early Life Impact) Scale. The third section further asked about the HRQoL and broader wellbeing of patients, including the social relationships, tiredness and sleep bolt-ons for the EQ-5D-5L, Rosenberg Self-Esteem Scale (RSES) and Brief Fear of Negative Evaluation Scale – Straightforward Items (BFNE-S). It also included FACE-Q scales, the Aging Appraisal, Appearance-Related Psychosocial Distress (hereafter: Appearance Distress), Early Life Impact of Treatment (hereafter: Early Life Impact), and the Patient-Perceived Age Visual Analogue Scale (hereafter: Age VAS). In addition, one question on bodily appearance (question 11 of the World Health Organization Quality of Life Brief Version (WHOQOL–BREF)) was included. The bolt-ons were presented in separate sections because the EQ-5D-5L with skin irritation and self-confidence bolt-ons, together, functioned as a pilot instrument under development, while the other bolt-ons were exploratory modifications at the time of the survey.

The final section gathered sociodemographic data and medical history, such as age, sex, place of residence, education, chronic diseases and employment status. The order of the standardized questionnaires and all questions was fixed. All survey questions were compulsory; therefore, respondents could not proceed to the next question without answering the preceding one. Participation was voluntary and anonymous, and no incentives were offered. The survey was programmed in Qualtrics (Qualtrics 2020, Provo, UT, USA). The questionnaire was tested by members of our research team, based on which we determined that a minimum of six minutes is required for respondents to

carefully read and comprehend its content. Speeding respondents (those completing the survey in less than six minutes) were excluded before the data analysis.

3.1.2 Outcome measures

EQ-5D-5L and bolt-ons

In this study, five additional, previously developed bolt-on dimensions were used for the descriptive system, including skin irritation, self-confidence, sleep, social relationships and tiredness (70,119–121). The five bolt-on items tested in this study are provided in the manuscript. A 5-level version was used for each bolt-on, similar to the EQ-5D-5L items. The skin irritation and self-confidence 5-level bolt-ons were developed for patients with psoriasis through literature review, qualitative interviews with patients, and consultation with a clinical expert (70,122). The sleep, tiredness and social relationships bolt-ons were initially developed as 3-level versions based on the literature and items of other generic preference-based measures and were later extended to 5-level versions (123–126). All five bolt-ons with the same or slightly different wording have since been psychometrically validated through qualitative and quantitative methods in multiple studies and populations. While the EQ-5D-5L has a Hungarian value set, index values were not computed in the present study due to the psychometric nature of the research (64).

RSES

The validated Hungarian version of the RSES was administered (127). The RSES is the most widely used measure of self-esteem that includes ten items, each rated on a four-point Likert scale (‘strongly agree’, ‘agree’, ‘disagree’, and ‘strongly disagree’). Items 2, 5, 6, 8, and 9 are reverse-scored (128,129). The total score ranges between 0 and 30, where higher scores represent higher self-esteem. A score below 15 indicates low self-esteem (130).

BFNE-S

We used the validated Hungarian version of the BFNE-S questionnaire (131). BFNE-S is an eight-item questionnaire that evaluates the degree to which an individual feels anxious about being judged negatively. Respondents are asked to rate each item using a 5-point Likert scale (from ‘not at all characteristic of me’ to ‘entirely characteristic of me’). The

total scores range from 8 to 40, with higher scores indicating worse fear of negative evaluation (132).

Bodily appearance question

We included one question from the WHOQOL-BREF general QoL measure for the sake of known group validity tests ('Are you able to accept your bodily appearance?') (46). The item is rated on a 5-point Likert-scale ('Not at all', 'A little', 'Moderately', 'Mostly', 'Completely').

3.1.3 Statistical analyses

We followed an analytical framework described in previous bolt-on studies (68,121), which included analyses both at level of dimensions and instrument (i.e., EQ-5D-5L with and without bolt-ons). All statistical analyses were conducted using R Statistical Software (version 4.3.2; R Foundation for Statistical Computing, Vienna, Austria). Significance level was set at 0.05 for all analyses.

Distributional characteristics, ceiling and informativity

Descriptive statistics were used to summarise the sociodemographic and clinical characteristics of the patients. The characteristics of the 'planning' group and the 'undergone' group were compared using Pearson's Chi-square test (with Yates correction where applicable) for categorical variables, and Student's t-test for continuous variables. The relative frequencies of patients' responses for different levels of EQ-5D-5L, bolt-ons, RSES, and BFNE-S were computed. To assess the ceiling, the proportion of patients having 'no problems' on one or all dimensions was computed. Both absolute (percentage point, pp) and relative (%) reductions in ceiling were determined after adding the bolt-ons. We also computed the frequency of different health state profiles for the EQ-5D-5L (+bolt-ons). Informativity was evaluated using Shannon's absolute informativity (H') and Shannon's evenness (relative informativity, J') indices. We first assessed the informativity for each bolt-on item (item-level informativity). Then, we assessed the informativity of the EQ-5D-5L with and without the bolt-on dimensions (instrument-level informativity) (133,134). H' can be defined as

$$H' = -\sum_{i=1}^{L} p_i * \log_2 p_i,$$

where L is the number of levels in a dimension, and p_i is the percentage of patients in the ith level (i = 1, …, L). J' measures the evenness of distribution and can be calculated as follows:

$$J' = \frac{H'}{H'_{max}}, \text{ where } H'_{max} = \log_2 L.$$

Higher H' and J' values indicate better informativity, where H' ranges from 0 to $\log_2 L$ and J' ranges from 0 to 1. We hypothesized that adding any bolt-ons would result in a reduction in ceiling and an improvement in informativity of the EQ-5D-5L.

Convergent and divergent validity

Spearman's rank-order correlations (r_s) were used for convergent and divergent validity analyses. The divergent validity of all five bolt-ons was examined with the core five EQ-5D-5L dimensions. We hypothesized (very) weak correlations between the bolt-ons and the core EQ-5D-5L dimensions with the exception of the self-confidence and social relationships bolt-ons and the EQ-5D-5L's anxiety/depression dimension, where we anticipated moderate or strong correlation (71,73,121). Convergent validity was investigated for the self-confidence and social relationships bolt-ons and the EQ-5D-5L's anxiety/depression dimension with the items and total scores of RSES and BFNE-S, which intend to measure a similar construct. We hypothesized at least moderate correlations between the bolt-ons and the item and total scores of RSES and BFNE-S, with stronger correlations expected for the self-confidence bolt-on (135). Correlations of the bolt-ons with EQ VAS were also investigated, with the strongest correlations being expected with the tiredness bolt-on (121,136). The absolute value of the correlation coefficient ($|r_s|$) was interpreted as follows: very weak (<0.20), weak (0.20-0.39), moderate (0.40-0.59), strong (0.60-0.79), and very strong (≥0.80) correlation (137).

Explanatory power

Univariable and multivariable linear regression analyses were used to compare the explanatory power of the EQ-5D-5L and bolt-on dimensions, using EQ VAS as dependent variable. In the univariable models, the association between EQ VAS and each dimension was examined individually. In the multivariable models, the bolt-on performing the best in univariable models was added to the model first, in addition to the five core dimensions. Additional bolt-ons were added as long as they increased the adjusted R^2.

Known-groups validity

Mean level sum scores (LSSs) were computed by adding up the responses on each dimension and standardized into a 0-100 scale to compare the known-groups validity of the EQ-5D-5L with bolt-on(s) to the EQ-5D-5L alone. The following seven variables were used to define known groups: bodily appearance question of WHOQOL-BREF (whole sample), self-esteem groups as measured by the RSES (whole sample), respondents who had undergone vs. those who planned to undergo MICPs (whole sample), type of procedure performed in the last two months ('undergone' group), date of the last procedure ('undergone' group), body mass index (BMI) (whole sample), and general health status on 5-point excellent-to-poor scale (whole sample). We hypothesized that respondents who are more accepting of their appearance, have higher self-esteem, have already undergone procedures compared to those planning them, had procedures one to two months ago versus one to two weeks ago, and had a normal BMI would report better overall HRQoL. We did not have a specific *a priori* hypothesis regarding which type of procedure (e.g., soft tissue augmentation, thread lifting, collagen induction therapies, or botulinum toxin treatment) would be associated with better or worse HRQoL outcomes. However, we generally hypothesized that differences in HRQoL might exist across these groups. Relative efficiency (RE) was calculated as the ratio of the F-statistic from the analysis of variance, where the EQ-5D-5L was taken as a reference (i.e., denominator) (138). An F-ratio >1 indicated that EQ-5D-5L with bolt-on(s) was more efficient at discriminating between subgroups than the EQ-5D-5L alone. To test whether the F-ratio statistically differs from 1, 95% confidence intervals were estimated using 2000 bootstrap samples with accelerated bias correction. Bolt-ons were added to the EQ-5D-5L as long as their inclusion resulted in a statistically significant improvement in RE.

3.2 FACE-Q study methods

3.2.1 Study population and study design

Details of the study population are provided in Section 3.1.1. For the FACE-Q study, respondents who reported undergoing non-facial MICPs were excluded because the selected FACE-Q scales are specific to facial procedures. The survey instrument is described in Section 3.1.2. Both studies were based on data from the same survey.

3.2.2 Outcome measures

FACE-Q Aesthetics scales

The HRQoL domain of the FACE-Q Aesthetics module contains 10 independently functioning scales (97).

The Aging Appraisal Scale consists of 7 items assessing patients' perceptions of their facial aging (e.g., looking into the mirror and in photos) (95). Items are rated on a 4-point Likert scale: 'definitely agree', 'somewhat agree', 'somewhat disagree', 'definitely disagree'. Respondents are asked to consider how they feel 'today' about the age their face looks (95).

The Appearance Distress Scale consists of 8 items assessing distress related to appearance, such as anxiety, stress and unhappiness. Items are rated on the same 4-point Likert scale (99). This scale is completed without a defined recall period, as it reflects respondents' general state.

The Early Life Impact Scale contains 12 items measuring the impact of a recent procedure by asking about the ability to do everyday activities (e.g., dining, social interactions) and statements about feelings (e.g., feeling anxious, tired). Responses are given on a 3-point Likert scale: 'most of the time', 'some of the time', 'not at all' (97). Participants are asked to answer with reference to the previous 2 days.

The Age VAS is a single-item measure that asks respondents to indicate how old they believe they look relative to their actual age, on a scale ranging from −15 to +15 years. Negative values indicate feeling younger, while positive values indicate feeling older, and a score of 0 reflects perceiving oneself to look exactly one's age (95). The recall period is unspecified.

Selecting a limited number of scales helped reduce respondent burden, as the Hungarian versions are intended for use in routine clinical settings. The selected scales reflect the most commonly reported motivations for undergoing MICPs, including improving cosmetic appearance, looking younger and increasing self-confidence (5). Accordingly, the Aging Appraisal Scale was included to capture the global perception of facial appearance, while the Age VAS was selected to assess perceived age. The Appearance Distress Scale was included to measure appearance-related psychological burden and self-confidence. In addition, for participants who had previously undergone MICPs,

the Early Life Impact Scale was included to assess the perceived short-term effects of MICPs.

3.2.3 Translation, cultural adaptation and comprehensibility

Permission to translate and use the FACE-Q scales to Hungarian was obtained from the original development team. The translation process followed the recommendations set forth by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) (139). Initially, the scales were translated from English to Hungarian (forward translation) by two independent translators (a consultant dermatologist and a dermatology resident), both native Hungarian speakers (target language) and proficient in English (source language). Based on the two forward translations, a reconciled Hungarian version was produced. Afterward, the Hungarian version was back-translated into English by a native English-speaking person fluent in Hungarian, who was blinded to the original English version. The original English version and the back translation were checked for accuracy by the FACE-Q development team. Comprehensibility (a key element of content validity) was evaluated during the translation and cultural adaptation process. Cognitive debriefing interviews were performed with a convenience sample of five native Hungarian speakers, three of whom were planning to undergo MICPs and two had already undergone MICPs. The cognitive debriefing interviews were conducted by a cosmetic dermatologist to assess whether any instructions, items or response options required modification to improve comprehensibility. Patients were asked how they interpreted the instructions and items, whether any wording was difficult to understand and whether improvements were needed. They were also asked to explain the meaning of the response options and the differences between them and to indicate if any part of the response options was difficult to understand. After the cognitive debriefing interviews, the finalized translation was sent back to the development team for approval. The final versions of each scale were included in the online cross-sectional survey.

3.2.4 Statistical analysis

Psychometric evaluation followed the recommendations of the COSMIN (112). The psychometric analyses were conducted for the total sample and, where appropriate, separately for the two subgroups (‘planning’ and ‘undergone’). All statistical analyses were performed using R Statistical Software (version 4.3.2; R Foundation for Statistical

Computing, Vienna, Austria). A significance level of 0.05 was used throughout. The following measurement properties were evaluated in this study: comprehensibility, floor and ceiling effects, structural validity assessed using principal component analysis (PCA) and confirmatory factor analysis (CFA), internal consistency and construct validity assessed through hypothesis testing (convergent, divergent and known-groups validity).

Descriptive statistics

Descriptive statistics were used to summarize the sociodemographic and clinical characteristics of the study population. Group differences between the 'planning' and 'undergone' participants were examined using χ^2 test (with Yates' continuity correction, where applicable) for categorical variables, and independent samples t-tests for continuous variables.

Raw item scores were summed for each multi-item FACE-Q scale and transformed using a Rasch-based Partial Credit Model and rescaled to a 0-100 range, where 0 represents the worst and 100 the best possible outcome (95,97,99). This approach is recommended as the FACE-Q instruments were developed using Rasch Measurement Theory, which enables transformation of ordinal responses into interval-level measures, thereby linearizing the data and improving the interpretability and comparability of scores (107). In line with this recommendation, for the assessment assess scale-level psychometric properties (e.g., ceiling, floor, convergent and known-groups validity), these Rasch-transformed scores were used. For item-based analyses (e.g., structural validity), the raw item responses were used.

For the FACE-Q scales, EQ VAS, RSES, and BFNE-S, we reported the minimum and maximum values, means and standard deviations (SD), as well as medians and interquartile ranges (IQR). Item-level FACE-Q distributions were reported as relative frequencies.

Ceiling and floor

For each FACE-Q scale, we computed the proportion of respondents reporting the maximum (ceiling) and minimum (floor) values. A proportion greater than 15% was considered indicative of a ceiling or floor effect (110).

Convergent and divergent validity

Convergent and divergent validity were assessed by testing *a priori* hypotheses regarding the associations between the FACE-Q scales and external measures. Pearson's correlation coefficients (r) were used for continuous variables (e.g., FACE-Q Rasch-transformed scores, EQ-5D-5L index value), and Spearman's rank-order correlations (r_s) were used for ordinal variables (e.g., FACE-Q items, EQ-5D-5L dimensions). Correlation strength was interpreted based on absolute values as follows: very weak (<0.20), weak (0.20-0.39), moderate (0.40-0.59), strong (0.60-0.79), and very strong (≥0.80) (137).

First, weak or very weak correlations were hypothesized between the FACE-Q scales and most EQ-5D-5L dimensions, index values, and EQ VAS scores. An exception was the anxiety/depression dimension, which was expected to show at least a moderate correlation with the Appearance Distress Scale. Second, strong correlations were expected between the Appearance Distress Scale and both the RSES and BFNE-S, reflecting conceptual overlap between appearance-related psychosocial distress, self-esteem and fear of negative evaluation. Third, moderate or strong correlations were anticipated between the Early Life Impact, Aging Appraisal scales and Age VAS and both the RSES and BFNE-S.

Structural validity

To assess structural validity, both PCA and CFA were conducted for all FACE-Q scales, except Age VAS. PCA was performed with varimax rotation. Sampling adequacy was evaluated using the Kaiser-Meyer-Olkin (KMO) statistic (140,141) and factorability was confirmed via Bartlett's test of sphericity (142). KMO values above 0.50 were deemed acceptable (143), and a significant Bartlett's test ($p<0.05$) indicated suitability for PCA (144). Factors were extracted based on the Kaiser's criterion (eigenvalues >1) (145), scree plot inspection, and parallel analysis (146). Factor loadings were interpreted as acceptable (≥0.30), practically significant (≥0.50), and representative of a well-defined structure (≥0.70) (145). Communalities (h^2) > 0.50 were considered acceptable (147).

CFA was used to confirm the factor structure of each FACE-Q scale. Due to the ordinal nature of the data, diagonally weighted least squares estimation with polychoric correlations was applied. Model fit was assessed using comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Acceptable model fit was defined as CFI>0.90 and RMSEA and SRMR≤0.08 (148).

Internal consistency and discrimination

Internal consistency of each scale as a whole was evaluated using Cronbach's alpha (α) coefficient. Cronbach's α coefficients were calculated for each scale and item discrimination was assessed using corrected item-total correlations and Cronbach's α if an item was deleted (149). Cronbach's α values above 0.80 were considered good, while values between 0.70 and 0.80 were acceptable, between 0.60 and 0.70 questionable, and below 0.60 poor (150). Internal consistency was assessed only for factors with three or more items.

Known-groups validity

Known-groups validity was assessed by comparing mean FACE-Q scale scores across subgroups *a priori* expected to differ. Participants were grouped by treatment status (planning vs. undergone MICPs), self-esteem (RSES <15 vs. ≥15), fear of negative evaluation (BFNE-S <25 vs. ≥25), and responses to the WHOQOL-BREF bodily appearance question.

Mean differences were tested using independent samples t-test (two categories) or analysis of variance (three or more categories). Effect sizes were calculated using Cohen's d for two groups comparisons and eta-squared (η^2) for three or more groups. Effect sizes were interpreted as negligible ($d<0.2$ or $\eta^2<0.01$), small ($0.2\leq d<0.5$ or $0.01\leq\eta^2<0.06$), medium ($0.5\leq d<0.8$ or $0.06\leq\eta^2<0.14$), and large ($0.8\leq d$ or $0.14\leq\eta^2$) (151).

We hypothesized that participants who had undergone MICPs reported higher self-esteem, lower fear of negative evaluation, or greater acceptance of their appearance would score more favorably on the FACE-Q scales, i.e., lower appearance distress, more positive aging appraisal, and a perceived age equal to or lower than their actual age.

4 Results

This chapter relies on the findings of the two publications of the candidate:

1. **Müller EM**, Nikl A, Krebs M, Holló P, Brodszky V, Kemény LV, Rencz F. Psychometric benefits of adding bolt-ons to the EQ-5D-5L in populations undergoing minimally invasive cosmetic procedures. Eur J Health Econ. 2025;26:1233–1247. doi:10.1007/s10198-025-01772-9.

2. **Müller EM**, Nikl A, Krebs M, Szabó Á, Holló P, Brodszky V, Rencz F, Kemény LV. Psychometric properties of four FACE-Q Aesthetics scales in patients planning and undergoing minimally invasive facial cosmetic procedures. Qual Life Res. 2026;35:201. doi:10.1007/s11136-026-04313-w.

4.1 Results of the bolt-on study

4.1.1 Characteristics of the study population

Out of 942 individuals who opened the questionnaire, 387 completed it (41.0%). We excluded five speeders (i.e., those who completed the survey in less than 6 minutes). Furthermore, the research team decided to exclude a small number of male (n=16) and nonbinary (n=2) respondents to ensure the homogeneity of the sample. Overall, 364 female participants were included in the data analysis. Among them, 215 participants had undergone, and 149 participants planned MICPs. The mean age of the total sample was 42.2 (SD=11.5) years, ranging from 19 to 71 years (Table 2). The mean age of the 'undergone' group and 'planning' group was similar (42.1 vs. 42.5). The most common chronic diseases among the total sample were allergies (19.5%), thyroid disease (17.6%), and hypertension (9.9%). The sample was highly educated.

Both in the 'undergone' and 'planning' groups, the three most important motivations for seeking MICPs were to feel better about oneself (85.6% and 81.2% at least slightly agreed), to look more attractive (74.0% and 78.5% at least slightly agreed), and to look younger (62.8% and 59.7% at least slightly agreed). In the 'undergone' group, the most common MICPs were botulinum toxin treatment (46.0%), lip augmentation (21.9%), and soft tissue augmentation of other areas of the face (20.9%). The majority of patients in

the ‘planning’ group were planning botulinum toxin treatment (42.0%), lip augmentation (33.2%), and laser resurfacing (25.8%). No significant difference was found between the two groups regarding their sociodemographic data. The mean EQ VAS score was significantly higher in the ‘undergone’ group compared to the ‘planning’ group (86.5 vs. 83.5; p=0.028). Furthermore, compared to the ‘undergone’ group, substantially more participants in the ‘planning’ group scored less than 15 on the RSES, suggesting low self-esteem (26.2% vs. 10.7%; p<0.001). Overall, 12.6% of the participants reported that they can accept their bodily appearance completely. The item-level responses on the RSES and BFNE-S are shown in Appendices 1 and 2.

Table 2. Characteristics of the study population (122)

Variables	**Total sample (n=364)**		**Group 1 (undergone) (n=215)**		**Group 2 (planning) (n=149)**		**p-value†**
	Mean or *n*	**SD or %**	**Mean or *n***	**SD or %**	**Mean or *n***	**SD or %**	
Age (years)							
19–24	11	3.0	6	2.8	5	3.4	0.546
25–34	107	29.4	61	28.4	46	30.9	
35–44	84	23.1	55	25.6	29	19.5	
45–54	105	28.8	60	27.9	45	30.2	
55–64	45	12.4	29	13.5	16	10.7	
65+	12	3.3	4	1.9	8	5.4	
Place of residence							
Capital	181	49.7	112	52.1	69	46.3	0.075
County town	83	22.8	39	18.1	44	29.5	
Other town	70	19.2	46	21.4	24	16.1	
Village	30	8.2	18	8.8	12	8.1	
Highest level of education							
Primary or secondary school	88	24.2	54	25.1	34	22.8	0.615
College/university	276	75.8	161	74.9	115	77.2	
Employment							
Full-time/self employed	291	79.9	177	82.3	114	76.5	0.219
Other	73	20.1	38	17.7	35	23.5	
Body mass index (BMI) (kg/m2)							
Underweight (below 18.5)	24	6.6	17	7.9	7	4.7	0.343
Normal (between 18.5 and 24.9)	226	62.1	139	64.7	87	58.4	
Overweight (between 25 and 29.9)	62	17.0	36	16.7	26	17.4	
Obese (30 or over)	20	5.5	9	4.2	11	7.4	

Variables	Total sample (n=364)		Group 1 (undergone) (n=215)		Group 2 (planning) (n=149)		p-value†
	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	
Type of procedure(s) performed in the last two months or planned in the next two months *							
Lip augmentation	96	26.4	47	21.9	49	33.2	0.019
Soft tissue augmentation of other part of the face	81	22.3	45	20.9	36	24.5	0.466
Mesotherapy	56	15.4	28	13.0	28	19.0	0.134
Botulinum toxin treatment	161	44.2	99	46.0	62	42.0	0.402
Monofilament thread therapy	20	5.5	4	1.9	16	11.1	p<0.001
COG thread lifting	34	9.3	8	3.7	26	17.8	p<0.001
Facial laser resurfacing	55	15.1	17	7.9	38	25.8	p<0.001
Medical grade peeling	22	6.0	6	2.8	16	10.9	p<0.001
Platelet rich plasma treatment	7	1.9	0	0.0	7	4.9	0.001
Other	21	5.8	14	6.5	7	4.8	0.466
Localisation of the procedure performed in the last two months or planned in the next two months *							
Upper third of the face	227	62.4	143	66.5	84	56.4	0.050
Middle third of the face	152	41.8	92	42.8	60	40.3	0.631
Lower third of the face	190	52.2	98	45.6	92	61.7	0.002
Other	16	4.4	12	5.6	4	2.7	0.185
Adverse reaction(s) observed after the latest procedure *							
No adverse reaction	-	-	145	67.4	-	-	-
Hematoma	-	-	41	19.1	-	-	-
Pain	-	-	28	13.0	-	-	-
Oedema	-	-	32	14.9	-	-	-
Other	-	-	33	15.3	-	-	-
Number of procedures in the last two months							
1	-	-	159	74.0	-	-	-
2	-	-	46	21.4	-	-	-
More than 2	-	-	10	4.7	-	-	-
Date of the last procedure							
Within one week	-	-	28	13.0	-	-	-
Within two weeks	-	-	31	14.4	-	-	-
Within one month	-	-	39	18.1	-	-	-
Within two months	-	-	117	54.4	-	-	-
Total number of procedures performed during the lifetime							
1–2	-	-	63	29.3	-	-	-
3–5	-	-	72	33.5	-	-	-

Variables	Total sample (n=364)		Group 1 (undergone) (n=215)		Group 2 (planning) (n=149)		p-value†
	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	
6–10	-	-	43	20.0	-	-	-
10–15	-	-	21	9.8	-	-	-
16–20	-	-	3	1.4	-	-	-
More than 20	-	-	13	6.0	-	-	-
Number of comorbidities							
0	143	39.3	90	41.9	53	35.6	0.682
1	132	36.3	75	34.9	57	38.3	
2–3	76	20.9	43	20.0	33	22.1	
4	13	3.6	7	3.3	6	4.0	
Most common chronic conditions*							
Allergies	71	19.5	43	20.0	28	17.8	0.775
Thyroid disease	64	17.6	34	15.8	30	19.1	0.287
Hypertension	36	9.9	17	7.9	19	12.1	0.128
Anxiety	27	7.4	18	8.4	9	5.7	0.404
Atopic dermatitis	18	4.9	8	3.7	10	6.4	0.196
Rheumatic disease	17	4.7	12	5.6	5	3.2	0.322
Diabetes	16	4.4	8	3.7	8	5.1	0.451
Asthma or chronic obstructive pulmonary disease (COPD)	16	4.4	11	5.1	5	3.2	0.420
Other dermatologic disease	15	4.1	9	4.2	6	3.8	0.940
Depression	12	3.3	6	2.8	6	3.8	0.726
Cardiovascular disease	10	2.7	5	2.3	5	3.2	0.791
Other disease	44	12.1	23	10.7	21	13.4	0.328
Rosenberg Self-Esteem Scale total score	21.0	6.3	21.9	5.7	19.8	6.9	0.002
Rosenberg Self-Esteem Scale total score ≥ 15	302	83.0	192	89.3	110	73.8	< 0.001
Rosenberg Self-Esteem Scale total score < 15	62	17.0	23	10.7	39	26.2	
Brief Fear of Negative Evaluation Scale-Straightforward Items total score	29.6	8.6	31.0	7.7	27.6	9.3	< 0.001
EQ visual analogue scale (EQ VAS) score	85.3	12.4	86.5	11.1	83.5	13.9	0.028

RSES Rosenberg Self-Esteem Scale, *BFNE-S* Brief Fear of Negative Evaluation Scale-Straightforward Items, *EQ VAS* EuroQol visual analogue scale, *SD* standard deviation. * = Respondents could choose more than one response option. The number of respondents who responded that they did not know and/or refused to answer was n = 32 (8.8%) for the body mass index (BMI) and n = 8 (2.2%) for the diagnosis of any chronic disease. The 'other' category of employment status includes part-time employed, unemployed, retired, homemaker and student. Values may range from 0 to 30 on the Rosenberg Self-Esteem Scale, 8 to 40 on the Brief Fear of Negative Evaluation Scale-Straightforward Items, and 0 to 100 on the EQ VAS. Higher scores indicate better status on the Rosenberg Self-Esteem Scale and EQ VAS, while worse status on the Brief Fear of Negative Evaluation Scale-Straightforward Items. †: For categorical variables, Pearson's chi-squared (with Yates continuity correction, where applicable) was used. For continuous variables, Student's t-test was used.

4.1.2 Distributional characteristics, ceiling, informativity

Table 3 displays the distribution of responses on the EQ-5D-5L and bolt-on dimensions. There were only smaller differences in the distribution of responses between the 'planning' group and the 'undergone' group on the EQ-5D-5L and bolt-on dimensions.

Notably, the 'planning' group reported more problems with anxiety/depression (53.0% vs. 35.3%), tiredness (82.6% vs. 68.4%) and sleep (62.4% vs. 49.8%). In the total sample, among the five core dimensions, self-care demonstrated the highest ceiling (99.5%), followed by mobility (91.2%), usual activities (89.6%), pain/discomfort (72.0%), and anxiety/depression (57.4%) (Table 3). Three bolt-ons showed lower ceiling than any of the five core dimensions: tiredness (25.8%), self-confidence (30.8%) and sleep (45.1%). Whereas the ceiling of social relationships (64.6%) and skin irritation (81.9%) were in the range of the EQ-5D-5L dimensions.

Table 3. Responses on five EQ-5D-5L dimensions and five bolt-ons (122)

	No problems		**Slight problems**		**Moderate problems**		**Severe problems**		**Extreme problems/ unable to**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total sample (n=364)										
Mobility (MO)	332	91.2	27	7.4	4	1.1	1	0.3	0	0.0
Self-care (SC)	362	99.5	1	0.3	1	0.3	0	0.0	0	0.0
Usual activities (UA)	326	89.6	29	8.0	7	1.9	2	0.5	0	0.0
Pain/discomfort (PD)	262	72.0	90	24.7	9	2.5	1	0.3	2	0.5
Anxiety/depression (AD)	209	57.4	115	31.6	30	8.2	7	1.9	3	0.8
Skin irritation bolt-on (SI)	298	81.9	50	13.7	13	3.6	0	0.0	3	0.8
Self-confidence bolt-on (SE)	112	30.8	144	39.6	77	21.2	27	7.4	4	1.1
Social relationships bolt-on (SR)	235	64.6	90	24.7	32	8.8	7	1.9	0	0.0
Tiredness bolt-on (TI)	94	25.8	160	44.0	75	20.6	26	7.1	9	2.5
Sleep bolt-on (SL)	164	45.1	139	38.2	45	12.4	13	3.6	3	0.8
Group 1 (undergone, n=215)										
Mobility (MO)	196	91.2	16	7.4	2	0.9	1	0.5	0	0.0
Self-care (SC)	214	99.5	0	0.0	1	0.5	0	0.0	0	0.0
Usual activities (UA)	200	93.0	12	5.6	2	0.9	1	0.5	0	0.0
Pain/discomfort (PD)	166	77.2	43	20.0	5	2.3	0	0.0	1	0.5
Anxiety/depression (AD)	139	64.7	53	24.7	20	9.3	3	1.4	0	0.0
Skin irritation bolt-on (SI)	182	84.7	23	10.7	10	4.7	0	0.0	0	0.0
Self-confidence bolt-on (SE)	72	33.5	89	41.4	43	20.0	10	4.7	1	0.5
Social relationships bolt-on (SR)	147	68.4	54	25.1	13	6.0	1	0.5	0	0.0
Tiredness bolt-on (TI)	68	31.6	97	45.1	40	18.6	8	3.7	2	0.9
Sleep bolt-on (SL)	108	50.2	81	37.7	20	9.3	6	2.8	0	0.0
Group 2 (planning, n=149)										
Mobility (MO)	136	91.3	11	7.4	2	1.3	0	0.0	0	0.0
Self-care (SC)	148	99.3	1	0.7	0	0.0	0	0.0	0	0.0

Usual activities (UA)	126	84.6	17	11.4	5	3.4	1	0.7	0	0.0
Pain/discomfort (PD)	96	64.4	47	31.5	4	2.7	1	0.7	1	0.7
Anxiety/depression (AD)	70	47.0	62	41.6	10	6.7	4	2.7	3	2.0
Skin irritation bolt-on (SI)	116	77.9	27	18.1	3	2.0	0	0.0	3	2.0
Self-confidence bolt-on (SE)	40	26.8	55	36.9	34	22.8	17	11.4	3	2.0
Social relationships bolt-on (SR)	88	59.1	36	24.2	19	12.8	6	4.0	0	0.0
Tiredness bolt-on (TI)	26	17.4	63	42.3	35	23.5	18	12.1	7	4.7
Sleep bolt-on (SL)	56	37.6	58	38.9	25	16.8	7	4.7	3	2.0

MO mobility, *SC* self-care, *UA* usual activities, *PD* pain/discomfort, *AD* anxiety/depression, *SI* skin irritation bolt-on, *SE* self-confidence bolt-on, *SR* social relationships bolt-on, *TI* tiredness bolt-on, *SL* sleep bolt-on

The ceiling in the EQ-5D-5L (considering all five dimensions combined) was 47.3%. Adding the tiredness, self-confidence, sleep, social relationships, and skin irritation individual bolt-ons to the EQ-5D-5L reduced the ceiling to 22.3%, 22.8%, 27.2%, 38.2% and 40.7%, respectively. Notably, self-confidence and tiredness together reduced the ceiling to 10.7%. When adding all five bolt-ons to the EQ-5D-5L, the ceiling was reduced to 7.1%. The number of observed health state profiles increased by adding bolt-ons to the EQ-5D-5L, with the largest rise being observed with tiredness (from 44 to 77).

Both absolute (H') and relative (J') informativity were higher for the self-confidence, tiredness and sleep bolt-ons than for any of the core EQ-5D-5L dimensions (Table 4). Absolute informativity increased with the addition of any of the five bolt-ons to the EQ-5D-5L. This was also true for relative informativity, except for skin irritation.

Table 4. Ceiling and informativity of EQ-5D-5L and bolt-ons (122)

	Ceiling		Ceiling [EQ-5D-5L + bolt-on(s)]		Absolute ceiling reduction (pp)	Relative ceiling reduction (%)	Item-level informativity		Informativity [EQ-5D-5L + bolt-on(s)]		Total number of health state profiles		
	n	%	n	%			Shannon's index H'	Shannon's evenness index J'	Shannon's index H'	Shannon's evenness index J'	n	%	max
EQ-5D-5L													
Mobility (MO)	332	91.2	172	47.3	-	-	0.49	0.21	2.99	0.26	44	1.4	3125
Self-care (SC)	362	99.5			-	-	0.05	0.02					
Usual activities (UA)	326	89.6			-	-	0.58	0.25					
Pain/discomfort (PD)	262	72.0			-	-	1.04	0.45					
Anxiety/depression (AD)	209	57.4			-	-	1.45	0.62					
(EQ-5D-5L +) bolt-ons													
Skin irritation bolt-on (SI)	298	81.9	148	40.7	6.6	14.0	0.86	0.37	3.66	0.26	63	0.4	15625
Self-confidence bolt-on (SE)	112	30.8	83	22.8	24.5	51.7	1.88	0.81	4.39	0.32	75	0.5	15625

	Ceiling		Ceiling [EQ-5D-5L + bolt-on(s)]		Absolute ceiling reduction (pp)	Relative ceiling reduction (%)	Item-level informativity		Informativity [EQ-5D-5L + bolt-on(s)]		Total number of health state profiles		
	n	%	n	%			Shannon's index H'	Shannon's evenness index J'	Shannon's index H'	Shannon's evenness index J'	n	%	max
Social relationships bolt-on (SR)	235	64.6	139	38.2	9.1	19.2	1.32	0.57	3.93	0.28	66	0.4	15625
Tiredness bolt-on (TI)	94	25.8	81	22.3	25.0	52.9	1.90	0.82	4.42	0.32	77	0.5	15625
Sleep bolt-on (SL)	164	45.1	99	27.2	20.1	42.4	1.65	0.71	4.32	0.31	76	0.5	15625
EQ-5D-5L+TI+SE	-	-	39	10.7	36.6	77.3	-	-	5.58	0.34	114	0.1	78125
EQ-5D-5L+TI+SE+SL	-	-	27	7.4	39.9	84.3	-	-	6.48	0.35	163	0.0	390625
EQ-5D-5L+TI+SE+SL+SR	-	-	26	7.1	40.2	84.9	-	-	6.07	0.29	198	0.0	1953125
EQ-5D-5L + all 5 bolt-ons	-	-	26	7.1	40.2	84.9	-	-	7.10	0.31	216	0.0	9765625

MO mobility, *SC* self-care, *UA* usual activities, *PD* pain/discomfort, *AD* anxiety/depression, *SI* skin irritation bolt-on, *SE* self-confidence bolt-on, *SR* social relationships bolt-on, *TI* Tiredness bolt-on, SL sleep bolt-on, H*'* absolute informativity, *J'*relative informativity, *pp* percentage point, *max* maximum

4.1.3 Convergent and divergent validity

In line with our hypotheses, moderate correlation was observed between self-confidence and anxiety/depression (r_s=0.515), and between social relationships and anxiety/depression (r_s=0.439) (Table 5). Tiredness, skin irritation and sleep bolt-ons exhibited only weak or very weak correlations with any of the five core dimensions. Tiredness was moderately correlated with EQ VAS (r_s =-0.415), while self-confidence, social relationships and sleep exhibited weak correlation (range of r_s: -0.293 to -0.321).

Table 5. Correlations between the EQ-5D-5L and bolt-on dimensions and EQ VAS (122)

Dimension/scale	Mobility (MO)	Self-care (SC)	Usual activities (UA)	Pain/discomfort (PD)	Anxiety/ depression (AD)	EQ VAS	Skin irritation bolt-on (SI)	Self-confidence bolt-on (SE)	Social relationships bolt-on (SR)	Tiredness bolt-on (TI)	Sleep bolt-on (SL)
Mobility (MO)	-	-	-	-	-	-	-	-	-	-	-
Self-care (SC)	0.120	-	-	-	-	-	-	-	-	-	-
Usual activities (UA)	0.342	0.227	-	-	-	-	-	-	-	-	-
Pain/discomfort (PD)	0.372	0.138	0.473	-	-	-	-	-	-	-	-
Anxiety/depression (AD)	0.093*	0.126	0.309	0.357	-	-	-	-	-	-	-
EQ VAS	-0.282	-0.114	-0.329	-0.426	-0.373	-	-	-	-	-	-
Skin irritation bolt-on (SI)	0.027*	0.074*	0.127	0.099*	0.111	-0.099*	-	-	-	-	-
Self-confidence bolt-on (SE)	-0.015*	0.043*	0.202	0.242	0.515	-0.321	0.232	-	-	-	-
Social relationships bolt-on (SR)	0.075*	0.107	0.266	0.221	0.439	-0.293	0.112	0.462	-	-	-
Tiredness bolt-on (TI)	0.207	0.101*	0.343	0.373	0.399	-0.415	0.127	0.386	0.355	-	-
Sleep bolt-on (SL)	0.160	0.121	0.211	0.252	0.312	-0.247	0.098*	0.241	0.207	0.393	-

EQ VAS EQ Visual Analogue Scale, *MO* mobility, *SC* self-care, *UA* usual activities, *PD* pain/discomfort, *AD* anxiety/depression, *SI* skin irritation bolt-on, *SE* self-confidence bolt-on, *SR* social relationships bolt-on, *TI* Tiredness bolt-on, SL sleep bolt-on

* = Spearman's correlation coefficient p-value ≥ 0.05.

The self-confidence bolt-on demonstrated strong correlation with both RSES and BFNE-S total scores (r_s=-0.679 and -0.656) (Table 6). The anxiety/depression dimension and social relationships bolt-ons correlated moderately with the same two external measures (range of r_s -0.462 to -0.560). The strengths of the correlations of the anxiety/depression dimension and self-confidence and social relationships bolt-ons with the items of RSES and BFNE-S were strong or moderate in 12, 17, and 10 of the 18 correlations, respectively, with the strongest correlations observed for the self-confidence bolt-on across all RSES and BFNE-S items.

Table 6. Convergent validity of the anxiety/depression dimension, self-confidence and social relationships bolt-ons (122)

	Anxiety/ depression	**Self-confidence (SE) bolt-on**	**Social relationships (SR) bolt-on**
Rosenberg Self-Esteem Scale			
On the whole, I am satisfied with myself.	-0.443	-0.589	-0.456
At times I think I am no good at all.	-0.526	-0.566	-0.425
I feel that I have a number of good qualities.	-0.330	-0.406	-0.323
I am able to do things as well as most other people.	-0.343	-0.381	-0.281
I feel I do not have much to be proud of.	-0.349	-0.418	-0.331
I certainly feel useless at times.	-0.504	-0.563	-0.412
I feel that I'm a person of worth, at least on an equal plane with others.	-0.330	-0.493	-0.366
I wish I could have more respect for myself.	-0.412	-0.517	-0.338
All in all, I am inclined to feel that I am a failure.	-0.495	-0.544	-0.445
I take a positive attitude toward myself.	-0.427	-0.581	-0.408
Total score	**-0.560**	**-0.679**	**-0.506**
Brief Fear of Negative Evaluation Scale – Straightforward Items			
I worry about what other people will think of me even when I know it doesn't make any difference.	-0.420	-0.556	-0.397
I am frequently afraid of other people noticing my shortcomings.	-0.412	-0.555	-0.419
I am afraid others will not approve of me.	-0.339	-0.450	-0.413
I am afraid that other people will find fault with me.	-0.378	-0.530	-0.410
When I am talking to someone, I worry about what they may be thinking about me.	-0.417	-0.559	-0.438
I am usually worried about what kind of impression I make.	-0.428	-0.584	-0.405
Sometimes I think I am too concerned with what other people think of me.	-0.425	-0.576	-0.390
I often worry that I will say or do the wrong things.	-0.541	-0.608	-0.366
Total score	**-0.494**	**-0.656**	**-0.462**

The numbers are Spearman's correlation coefficients. P-value < 0.05 for all correlation coefficients.

4.1.4 Explanatory power

The results of the univariable linear regression analysis revealed that usual activities (adjusted R^2=0.196) and pain/discomfort (adjusted R^2=0.241) demonstrated the highest explanatory power for the variance of EQ VAS scores among the core EQ-5D-5L dimensions (Table 7). Tiredness (adjusted R^2=0.240) and self-confidence (adjusted R^2=0.181) performed the best among the bolt-ons. Adding two bolt-ons (tiredness and self-confidence) to the EQ-5D-5L improved the explained variance of EQ VAS scores, raising the adjusted R^2 from 0.369 to 0.445. No further improvement in adjusted R^2 was achieved after the second bolt-on.

Table 7. The explanatory power of EQ-5D-5L and bolt-ons on EQ VAS (122)

Selection of dimensions	EQ VAS	
	Adjusted R^2	ΣΔ adjusted R^2
EQ-5D-5L dimensions		
Mobility (MO)	0.115	-
Self-care (SC)	0.021	-
Usual activities (UA)	0.196	-
Pain/discomfort (PD)	0.241	-
Anxiety/depression (AD)	0.180	-
Bolt-on dimensions		
Skin irritation bolt-on (SI)	0.021	-
Self-confidence bolt-on (SE)	0.181	-
Social relationships bolt-on (SR)	0.122	-
Tiredness bolt-on (TI)	0.240	-
Sleep bolt-on (SL)	0.086	-
EQ-5D-5L(+bolt-on) dimensions		
MO+SC+UA+PD+AD	0.369	-
MO+SC+UA+PD+AD+TI	0.412	0.043
MO+SC+UA+PD+AD+TI+SE	0.445	0.033

EQ VAS EQ Visual Analogue Scale, *MO* mobility, *SC* self-care, *UA* usual activities, *PD* pain/discomfort, A*D* anxiety/depression, *SI* skin irritation bolt-on, *SE* self-confidence bolt-on, *SR* social relationships bolt-on, *TI* tiredness bolt-on, *SL* sleep bolt-on, R^2 coefficient of determination

4.1.5 Known-groups validity

The addition of tiredness bolt-on significantly improved the EQ-5D-5L's ability to discriminate between groups of participants based on whether they had undergone a MICP or were planning to, with a RE of 2.03 (95%CI 1.25-9.11) (Table 8). The addition

of the self-confidence and social relationships bolt-ons significantly increased the known-groups validity concerning the self-esteem groups based on RSES and bodily appearance, with RE values of 2.82 (95%CI 1.96-4.81) and 2.72 (95%CI 1.96-4.71), respectively. For the following known-groups, none of the bolt-ons improved the discriminatory power compared to the EQ-5D-5L: type of procedure performed in the last two months, date of the last procedure, BMI and general health status.

Table 8. Known-groups validity of the EQ-5D-5L and bolt-ons (122)

	Mean (SD) EQ-5D-5L+bolt-on(s) LSS (0-100)					**RE (95% CI*), ref: previous row**	**RE (95% CI*), ref: no bolt-ons**
Subgroups	**Group 1 (undergone)**	**Group 2 (planning)**					
n	**215**	**149**				-	-
EQ-5D-5L	4.72 (7.76)	7.18 (8.67)				-	-
EQ-5D-5L + TI	7.98 (8.61)	12.00 (10.30)				2.03 (1.25-9.11)	2.03 (1.25-9.11)
Total score on the Rosenberg Self-Esteem Scale (RSES)	**RSES< 15**	**RSES≥ 15**	-				
n	**62**	**302**				-	-
EQ-5D-5L	12.3 (8.95)	4.37 (7.38)				-	-
EQ-5D-5L + SE	19.60 (9.35)	7.19 (7.65)				2.23 (1.68-3.44)	2.23 (1.68-3.44)
EQ-5D-5L + SE + SR	21.20 (9.44)	7.32 (7.61)				1.26 (1.08-1.49)	2.82 (1.96-4.81)
Are you able to accept your bodily appearance?	**Not at all**	**A little**	**Moderately**	**Mostly**	**Completely**		
n	**17**	**31**	**83**	**187**	**46**	-	-
EQ-5D-5L	12.90 (12.00)	11.00 (9.70)	7.77 (7.54)	4.20 (7.65)	2.07 (4.02)	-	-
EQ-5D-5L + SE	19.10 (13.70)	17.90 (9.63)	12.80 (7.68)	7.11 (7.79)	2.54 (4.60)	2.36 (1.79 - 3.73)	2.36 (1.79-3.73)
EQ-5D-5L + SE + SR	20.40 (13.90)	19.20 (10.10)	13.40 (8.14)	7.22 (7.71)	2.64 (4.08)	1.15 (1.01-1.35)	2.72 (1.96-4.71)

TI tiredness bolt-on, *SE* self-confidence bolt-on, *SR* social relationships bolt-on, *RE* relative efficiency, *CI* Confidence interval, *LSS* mean level sum scores, *RSES* Rosenberg Self-Esteem Scale (RSES). Scores less than 15 indicate low self-esteem on the RSES. * =2000 bootstrap samples with accelerated bias correction.

4.2 Results of the FACE-Q study

4.2.1 Characteristics of the study population

The final analytic sample consisted of 357 women, of whom 210 had recently undergone, and 147 were planning MICPs (Table 9). Of the 942 individuals who opened the questionnaire, 387 completed it (response rate: 41.0%). To ensure a homogeneous study population, men (n=16) and nonbinary (n=2) respondents were excluded. Furthermore,

in line with the exclusion criteria, ‘speeders’ (i.e., those who completed the survey too quickly, n=5) and others who reported undergoing non-facial MICP(s) (n=7) were also excluded from the analysis.

The mean age of the total sample was 42.3 years (SD=11.5, range: 19-71), with no significant age difference between the ‘undergone’ (mean=42.2, SD=10.9) and ‘planning’ (mean=42.5, SD=12.4) groups (Table 9). The two subsamples did not differ significantly in sociodemographic characteristics, including education level, residence or employment status. In the ‘undergone’ group, the most frequent MICPs were botulinum toxin treatment (46.2%), lip augmentation (21.0%), and soft tissue augmentation (20.5%). In the ‘planning’ group, participants most often planned botulinum toxin treatment (42.2%), lip augmentation (34.0%), and laser resurfacing (25.2%).

Table 9. Characteristics of the study population (152)

Variables	**Total sample (n=357)**		**Group 1 (undergone) (n=210)**		**Group 2 (planning) (n=147)**		**p-value** [d]
	Mean or *n*	**SD or %**	**Mean or *n***	**SD or %**	**Mean or *n***	**SD or %**	
Age (years)							
19–24	11	3.1	6	2.9	5	3.4	0.378
25–34	104	29.1	59	28.1	45	30.6	
35–44	82	23.0	53	25.2	29	19.7	
45–54	103	28.9	59	28.1	44	29.9	
55–64	45	12.6	29	13.8	16	10.9	
65+	12	3.4	4	1.9	8	5.4	
Place of residence							
Capital	178	49.9	111	52.9	67	45.6	0.053
County town	81	22.7	37	17.6	44	29.9	
Other town	68	19.0	44	21.0	24	16.3	
Village	30	8.4	18	8.6	12	8.2	
Highest level of education							
Primary or secondary school	86	24.1	53	25.2	33	22.4	0.521
College/university	271	75.9	157	74.8	114	77.6	
Employment [a]							
Full-time/self employed	286	80.1	173	82.4	113	76.9	0.015
Other	71	19.9	37	17.6	34	23.1	
Body mass index (BMI) (kg/m^2) [b]							
Underweight (below 18.5)	22	6.2	16	7.6	6	4.1	0.106
Normal (between 18.5 and 24.9)	223	62.5	137	65.2	86	58.5	
Overweight (between 25 and 29.9)	61	17.1	35	16.7	26	17.7	
Obese (30 or over)	19	5.3	8	3.8	11	7.5	
Type of procedure(s) performed in the last two months or planned in the next two months [c]							
Lip augmentation	94	26.3	44	21.0	50	34.0	0.003
Soft tissue augmentation of other part of the face	81	22.7	43	20.5	38	25.9	0.164
Mesotherapy	55	15.4	27	12.9	28	19.0	0.070
Botulinum toxin treatment	159	44.5	97	46.2	62	42.2	0.401
Fine thread lifting	20	5.6	4	1.9	16	10.9	<0.001
Cog thread lifting	35	9.8	9	4.3	26	17.7	<0.001

Variables	Total sample (n=357)		Group 1 (undergone) (n=210)		Group 2 (planning) (n=147)		p-value [d]
	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	
Facial laser resurfacing	55	15.4	18	8.6	37	25.2	<0.001
Medical grade peeling	21	5.9	6	2.9	15	10.2	0.002
Platelet rich plasma treatment	7	2.0	0	0.0	7	4.8	<0.001
Other	19	5.3	14	6.7	5	3.4	0.118
Localisation of the procedure performed in the last two months or planned in the next two months [c]							
Upper third of the face	221	61.9	138	65.7	83	56.5	0.076
Middle third of the face	149	41.7	88	41.9	61	41.5	0.939
Lower third of the face	184	51.5	93	44.3	91	61.9	0.001
Other	15	4.2	9	4.3	6	4.1	0.925
Adverse reaction(s) observed after the latest procedure [c]							
No adverse reaction	-	-	139	66.2	-	-	-
Hematoma	-	-	41	19.5	-	-	-
Pain	-	-	27	12.9	-	-	-
Oedema	-	-	31	14.8	-	-	-
Other	-	-	31	14.8	-	-	-
Number of procedures in the last two months							
1	-	-	155	73.8	-	-	-
2	-	-	45	21.4	-	-	
More than 2	-	-	10	4.8	-	-	
Date of the last procedure							
Within one week	-	-	28	13.3	-	-	-
Within two weeks	-	-	31	14.8	-	-	
Within one month	-	-	37	17.6	-	-	
Within two months	-	-	114	54.3	-	-	
Total number of procedures performed during the lifetime							
1–2	-	-	61	29.0	-	-	-
3–5	-	-	70	33.3	-	-	
6–9	-	-	42	20.0	-	-	
10–15	-	-	21	10.0	-	-	
16–20	-	-	3	1.4	-	-	
More than 20	-	-	13	6.2	-	-	
Number of chronic diseases [b]							
0	141	39.5	89	42.4	52	35.4	0.578
1	129	36.1	73	34.8	56	38.1	
2–3	75	21.0	42	20.0	33	22.4	
4	12	3.4	6	2.9	6	4.1	
Most common chronic conditions [c]							
Allergies	69	19.3	41	19.5	28	19.0	0.911
Thyroid disease	62	17.4	32	15.2	30	20.4	0.204
Hypertension	35	9.8	16	7.6	19	12.9	0.097
Anxiety	26	7.3	17	8.1	9	6.1	0.480
Atopic dermatitis	17	4.8	7	3.3	10	6.8	0.130
Rheumatic disease	16	4.5	11	5.2	5	3.4	0.409
Diabetes	16	4.5	8	3.8	8	5.4	0.463
Asthma or chronic obstructive pulmonary disease	16	4.5	11	5.2	5	3.4	0.409
Other dermatologic disease	14	3.9	8	3.8	6	4.1	0.896
Depression	12	3.4	6	2.9	6	4.1	0.528
Cardiovascular disease	10	2.8	5	2.4	5	3.4	0.565
Other disease	42	11.8	22	10.5	20	13.6	0.366

a – The 'other' category of employment status includes part-time employed, unemployed, retired, homemaker and student.
b – The number of respondents who responded do not know and/or refused to answer was n = 22 (6.2%) for the body mass index (BMI) and n = 8 (2.2%) for the diagnosis of any chronic disease.
c – Respondents could choose more than one.
d – Pearson's χ^2 (with Yates' continuity correction, where applicable) was used for categorical variables.

4.2.2 Comprehensibility

The cognitive debriefing interviews indicated that the instructions, items and response options were understandable in the context of MICPs. One small modification to the initial Hungarian version of the Age VAS was required: the first sentence was revised to emphasize ‘how old you believe you look’ rather than ‘how old you look’. Moreover, the labels of the Likert scales for the Aging Appraisal and Appearance Distress scales were slightly revised to improve clarity and distinguishability of the response levels in Hungarian. The original response options (‘not at all agree’, ‘slightly disagree’, ‘slightly agree’, ‘completely agree’) were reworded for clarity (‘definitely disagree’, ‘somewhat disagree’, ‘somewhat agree’, ‘definitely agree’) (literal back-translation from Hungarian to English).

4.2.3 Outcome measures and group comparisons

Table 10 summarizes the descriptive statistics of the FACE-Q scales, EQ-5D-5L index values, EQ VAS, BFNE-S and RSES by treatment status. Compared to the ‘planning’ group, participants who had undergone reported more favorable scores on the FACE-Q Aging Appraisal (72.90 vs. 63.26; $p<0.001$) and Appearance Distress Scale (77.13 vs. 68.44; $p<0.001$) and perceived themselves as looking younger than their actual age (-4.97 vs. -2.81 years; $p<0.001$). They also showed slightly better general HRQoL as indicated by the EQ-5D-5L index values (0.96 vs. 0.93; $p=0.017$) and EQ VAS scores (86.57 vs. 83.57; $p=0.032$), as well as lower fear of negative evaluation (17.02 vs. 20.42; $p<0.001$), and higher self-esteem (21.99 vs. 19.88; $p=0.003$). Among participants who had already undergone MICPs, the Early Life Impact Scale yielded a mean score of 75.29 (SD= 20.67).

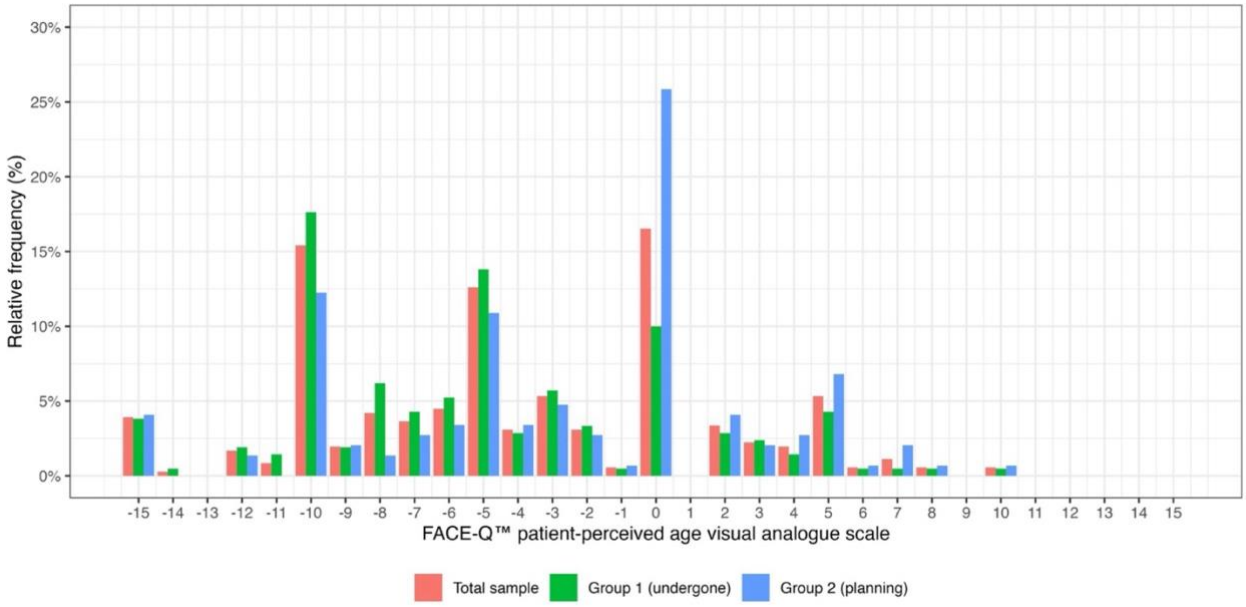
Table 10. Descriptive statistics of FACE-Q scales and other outcome measures (152)

	Theoretical range	Total sample (n=357)				Group 1. (undergone, n=210)				Group 2. (planning, n=147)				Group 1 mean vs Group 2 mean
		Min (%)	*Max (%)*	*Mean (SD)*	*Median (IQR)*	*Min (%)*	*Max (%)*	*Mean (SD)*	*Median (IQR)*	*Min (%)*	*Max (%)*	*Mean (SD)*	*Median (IQR)*	*independent-sample's t-test p-value*
FACE-Q Early Life Impact	0 to 100	-	-	-	-	1 (0.5%)	59 (28.1%)	75.29 (20.67)	71.01 (37.29)	-	-	-	-	-
FACE-Q Aging Appraisal	0 to 100	4 (1.2%)	71 (19.9%)	68.93 (23.10)	68.01 (38.08)	1 (0.5%)	51 (24.3%)	72.90 (22.02)	71.89 (32.34)	3 (2.0%)	20 (13.6%)	63.26 (23.48)	61.37 (32.40)	<0.001
FACE-Q Appearance Distress	0 to 100	3 (0.8%)	93 (26.1%)	73.55 (21.90)	72.80 (40.97)	2 (1.0%)	65 (31.0%)	77.13 (21.01)	76.89 (36.18)	1 (0.7%)	28 (19.1%)	68.44 (22.19)	66.47 (36.22)	<0.001
FACE-Q Age VAS	-15 to 15	14 (3.9%)	0 (0.0%)	-4.06 (5.53)	-5 (9)	8 (3.8%)	0 (0.0%)	-4.97 (5.31)	-5 (9)	6 (4.1%)	0 (0.0%)	-2.81 (5.60)	-2 (6.25)	0.219
EQ-5D-5L index values	-0.848 to 1	0 (0.0%)	170 (47.6%)	0.95 (0.10)	0.96 (0.08)	0 (0.0%)	114 (54.3%)	0.96 (0.09)	1 (0.04)	0 (0.0%)	56 (38.1%)	0.93 (0.11)	0.96 (0.08)	0.017
EQ VAS	0 to 100	0 (0.0%)	35 (9.8%)	85.33 (12.46)	90 (14)	0 (0.0%)	21 (10.0%)	86.57 (11.15)	90 (12.75)	0 (0.0%)	14 (9.5%)	83.57 (13.97)	89 (16)	0.032
Brief version of the Fear of Negative Evaluation Scale - Straightforward Items (BFNE-S)	8 to 40	25 (7.0%)	4 (1.1%)	18.42 (8.59)	16 (11)	18 (8.6%)	1 (0.5%)	17.02 (7.70)	15 (9)	7 (4.8%)	3 (2.0%)	20.42 (9.39)	18 (15)	<0.001
Rosenberg Self-Esteem Scale (RSES)	0 to 30	1 (0.3%)	36 (10.1%)	21.12 (6.32)	22 (10)	1 (0.5%)	19 (9.1%)	21.99 (5.76)	22 (7.75)	0 (0.0%)	17 (11.6%)	19.88 (6.88)	20 (12)	0.003

FACE-Q scale scores were calculated using a Rasch-based Partial Credit Model, rescaled to a 0–100 range (0 = worst, 100 = best). SD=Standard deviation. IQR=Interquartile range

Figure 1 illustrates the distribution of perceived age differences across the total sample and by subgroup. While responses in the 'planning' group clustered around zero, those in the 'undergone' group more frequently reported feeling 5 to 10 years younger than their chronological age. The distribution of the responses on the other three scales is presented in Appendices 3, 4 and 5.

Figure 1. Distribution of FACE-Q Age VAS (152)



4.2.4 Ceiling and floor effects

In the total sample, 19.9% of participants achieved the maximum possible score on the Aging Appraisal Scale and 26.1% on the Appearance Distress Scale, while 47.6% reached the maximum on the EQ-5D-5L index value and 9.8% on the EQ VAS. In the 'undergone' group, the proportions of participants achieving the maximum score were 24.3% for Aging Appraisal Scale, 31.0% for Appearance Distress Scale, 54.3% for the EQ-5D-5L index value and 10.0% for the EQ VAS. In the 'planning' group, the corresponding proportions were 13.6%, 19.1%, 38.1%, and 9.5%, respectively (Table 10). None of the four FACE-Q scales showed floor effects across any subgroup.

4.2.5 Convergent and divergent validity

In line with our hypothesis, the FACE-Q scales showed weak or very weak correlations with EQ-5D-5L dimensions, index values, and EQ VAS (Table 11). The Appearance Distress Scale demonstrated a moderate correlation with EQ-5D-5L anxiety/depression (r_s=-0.519) and with the EQ VAS (r_s=0.410). This scale also showed strong correlations with both the RSES (r=0.742) and BFNE-S total scores (r=-0.702).

Table 11. Convergent and divergent validity of the FACE-Q scale scores (152)

	FACE-Q Early Life Impact scale	**FACE-Q Aging Appraisal scale**	**FACE-Q Appearance Distress**	**FACE-Q Age VAS**
EQ-5D-5L				
Mobility	-0.066*	-0.181	-0.108	-0.032*
Self-care	-0.075*	-0.073*	-0.054*	-0.071*
Usual activities	-0.138	-0.232	-0.277	0.114
Pain/discomfort	-0.114*	-0.185	-0.328	0.142
Anxiety/depression	-0.225	-0.185	-0.519	0.223
EQ-5D-5L index values	0.170	0.262	0.372	-0.101*
EQ VAS scores	0.248	0.311	0.410	-0.155
Rosenberg Self-Esteem Scale	0.213	0.320	0.742	-0.423
Brief Fear of Negative Evaluation Scale – Straightforward Items	-0.248	-0.359	-0.702	0.415

Pearson's correlation was used for continuous variables, and Spearman's rank-order correlation for ordinal dimensions. * = correlation coefficient p-value ≥ 0.05

As anticipated, most items from the Early Life Impact and Aging Appraisal scales showed weak or very weak correlations with EQ-5D-5L dimensions, except for six items of the Appearance Distress Scale, which moderately correlated with the EQ-5D-5L anxiety/depression dimension (Table 12).

Table 12. Convergent and divergent validity of the EQ-5D-5L dimensions (152)

Items	**EQ-5D-5L**				
	Mobility	**Self-care**	**Usual activities**	**Pain/ discomfort**	**Anxiety/ depression**
FACE-Q Early Life Impact - items					
Item 1 – Regret	0.054*	0.013*	0.045*	0.056*	-0.013*
Item 2 – Anxious	-0.087*	-0.193	-0.188	-0.170	-0.167
Item 3 – Sleeping	-0.141	-0.122*	-0.168	-0.123*	-0.145*
Item 4 – Worthwhile	0.018*	0.032*	-0.007*	-0.096*	0.006*
Item 5 – Tired	0.044*	0.020*	-0.162	-0.062*	-0.146*
Item 6 – Head movements	0.062*	0.044*	0.068*	0.093*	-0.097*
Item 7 – Usual activities	-0.010*	0.024*	-0.113*	0.038*	-0.002*
Item 8 – Facial movements	0.035*	0.047*	-0.024*	0.053*	-0.096*

Items	EQ-5D-5L				
	Mobility	**Self-care**	**Usual activities**	**Pain/ discomfort**	**Anxiety/ depression**
Item 9 – Drinking	0.006*	0.020*	-0.047*	-0.087*	-0.204
Item 10 – Eating	-0.026*	0.017*	-0.088*	-0.166	-0.187
Item 11 – Social situations	-0.092*	0.030*	-0.118*	0.009*	-0.126
Item 12 – Intimacy	-0.101*	-0.198	-0.201	-0.098*	-0.123*
FACE-Q Appearance Distress items					
Item 1 – Feel unhappy	-0.062*	-0.011*	-0.199	-0.273	-0.413
Item 2 – Feel stressed	-0.098*	-0.010*	-0.171	-0.244	-0.387
Item 3 – Feel down	-0.082*	0.041*	-0.222	-0.317	-0.423
Item 4 – Feel anxious	-0.046*	-0.001*	-0.181	-0.276	-0.458
Item 5 – Look normal	-0.089*	-0.015*	-0.123	-0.158	-0.331
Item 6 – Ugly	-0.050*	0.008*	-0.132	-0.217	-0.441
Item 7 – Avoid people	-0.073*	-0.077*	-0.265	-0.289	-0.462
Item 8 – Doing things	-0.119	-0.078*	-0.304	-0.340	-0.417
FACE-Q Aging Appraisal - items					
Item 1 – Don't recognize	-0.192	-0.092*	-0.297	-0.188	-0.194
Item 2 – Look in mirror	-0.162	-0.059*	-0.313	-0.305	-0.330
Item 3 – Bothered	-0.226	-0.043*	-0.216	-0.195	-0.165
Item 4 – Older	-0.107	0.007*	-0.207	-0.172	-0.153
Item 5 – Worried	-0.130	-0.064*	-0.160	-0.124	-0.113
Item 6 – Photos	-0.149	-0.033*	-0.212	-0.197	-0.182
Item 7 – Reflection	-0.143	-0.027*	-0.211	-0.150	-0.172

Spearman's rank-order correlation was used to assess associations between individual FACE-Q scale items and EQ-5D-5L dimensions.
* = correlation coefficient p-value ≥ 0.05

4.2.6 Principal component analysis

PCA identified a four-factor structure for the Early Life Impact Scale, with most items loading onto one of the four factors. Item 5 and item 7 showed lower factor loadings, while item 11 cross-loaded on two factors. In contrast, the Aging Appraisal and Appearance Distress Scale demonstrated clear unidimensionality, with consistently high factor loadings and communalities across all samples. Factor loadings ranged from 0.67 to 0.87 for the Aging Appraisal Scale and from 0.55 to 0.88 for the Appearance Distress Scale in the total sample. One item showed relatively weaker performance on each scale across all samples: item 2 on the Aging Appraisal and item 8 on the Appearance Distress Scale, both showing the lowest factor loadings and communalities in their respective scales (Table 13).

Table 13. Results of the principal component analysis of the FACE-Q scales (152)

	Total sample (n=357)		**Group 1. (undergone, n=210)**					**Group 2. (planning, n=147)**	
	Factor loadings	**Communalities (h^2)**	**Factor 1 loadings *'Social and functional difficulties'***	**Factor 2 loadings *'Post-procedure regret and anxiety'***	**Factor 3 loadings *'Movement and activity limitations'***	**Factor 4 loadings *'Sleep disturbance and fatigue'***	**Communalities (h^2)**	**Factor loadings**	**Communalities (h^2)**
FACE-Q Early Life Impact - items									
Item 1 - Regret	-	-		0.610			0.373	-	-
Item 2 - Anxious	-	-		0.429			0.234	-	-
Item 3 - Sleeping	-	-				0.602	0.482	-	-
Item 4 - Worthwhile	-	-		0.596			0.372	-	-
Item 5 - Tired	-	-				0.465	0.227	-	-
Item 6 - Head movements	-	-			0.633		0.405	-	-
Item 7 - Usual activities	-	-			0.407		0.324	-	-
Item 8 - Facial movements	-	-			0.686		0.569	-	-
Item 9 - Drinking	-	-	0.776				0.624	-	-
Item 10 - Eating	-	-	0.780				0.684	-	-
Item 11 - Social situations	-	-	0.434	0.409			0.436	-	-
Item 12 - Intimacy	-	-	0.647				0.582	-	-
Kaiser-Meyer-Olkin measure (KMO)	-	-	0.708					-	-
Bartlett's test	-	-	χ^2 = 586.35 (*df* = 66), p<0.001					-	-
	Factor loadings	**Communalities (h^2)**	**Factor loadings**				**Communalities (h^2)**	**Factor loadings**	**Communalities (h^2)**
FACE-Q Aging Appraisal - items									
Item 1 - Don't recognize	0.726	0.527	0.687				0.472	0.748	0.559
Item 2 - Look in mirror	0.672	0.452	0.722				0.521	0.593	0.352
Item 3 - Bothered	0.872	0.760	0.841				0.707	0.899	0.808
Item 4 - Older	0.805	0.649	0.767				0.588	0.834	0.696
Item 5 - Worried	0.765	0.586	0.765				0.585	0.765	0.586
Item 6 - Photos	0.838	0.701	0.819				0.671	0.845	0.714
Item 7 - Reflection	0.870	0.757	0.867				0.752	0.876	0.767
Kaiser-Meyer-Olkin measure (KMO)	0.899		0.891					0.883	
Bartlett's test	χ^2 = 1819.66 (*df* = 21), p<0.001		χ^2 = 1005.35 (*df* = 21), p<0.001					χ^2 = 785.64 (*df* = 21), p<0.001	
FACE-Q Appearance Distress - items									
Item 1 - Feel unhappy	0.842	0.710	0.813				0.661	0.865	0.749
Item 2 - Feel stressed	0.823	0.678	0.812				0.659	0.825	0.681
Item 3 - Feel down	0.848	0.718	0.849				0.721	0.835	0.697
Item 4 - Feel anxious	0.881	0.776	0.850				0.723	0.908	0.825
Item 5 - Look normal	0.746	0.557	0.724				0.525	0.753	0.567
Item 6 - Ugly	0.830	0.689	0.806				0.650	0.841	0.707
Item 7 - Avoid people	0.710	0.504	0.712				0.506	0.688	0.474

Item 8 - Doing things	0.546	0.298	0.540	0.291	0.523	0.273
Kaiser-Meyer-Olkin measure (KMO)	0.917		0.907		0.908	
Bartlett's test	χ^2 = 2103.99 (*df* = 28), p<0.001		χ^2 = 1129.61 (*df* = 28), p<0.001		χ^2 = 904.71 (*df* = 28), p<0.001	

Factor loadings > 0.40 are shown in the table.

4.2.7 Confirmatory factor analysis

CFA generally supported the factorial structure of FACE-Q scales (Table 14). For the Early Life Impact Scale, the four-factor model could not be tested because one factor comprised only two items; therefore, a three-factor model (excluding items 3 and 5) was evaluated. In the 'undergone' group, model fit indices were CFI=0.988, RMSEA=0.050, and SRMR=0.118. For the Aging Appraisal and Appearance Distress scales, CFI values ranged from 0.996 to 0.998 and SRMR from 0.056 to 0.069, while RMSEA values ranged from 0.071 to 0.130, with the highest values observed in the 'planning' group (0.108–0.130).

Table 14. Results of the confirmatory factor analysis (152)

	CFI	RMSEA	SRMR
FACE-Q Early Life Impact			
Group 1 (undergone, n=210)			
Three-factor model excluding items 3 and 5	**0.988**	**0.050**	0.118
FACE-Q Aging Appraisal			
Total sample (n=357)			
One-factor model including all items	**0.996**	0.118	**0.058**
Group 1 (undergone, n=210)			
One-factor model including all items	**0.997**	0.097	**0.063**
Group 2 (planning, n=147)			
One-factor model including all items	**0.996**	0.130	**0.063**
FACE-Q Appearance Distress			
Total sample (n=357)			
One-factor model including all items	**0.997**	0.095	**0.058**
Group 1 (undergone, n=210)			
One-factor model including all items	**0.998**	**0.071**	**0.056**
Group 2 (planning, n=147)			
One-factor model including all items	**0.997**	0.108	**0.069**

Recommended values: CFI>0.90, RMSEA and SRMR≤0.08. Values meeting the cut-off criteria are indicated in bold. CFI comparative fit index, RMSEA root mean square error of approximation, SRMR standardized root mean square residual

4.2.8 Internal consistency and discrimination

Cronbach's α coefficients for the Early Life Impact Scale ranged from 0.605 to 0.754 across factors (Table 15). The highest internal consistency was observed for Factor 1 (α=0.754), while Factors 2 and 3 showed lower values (α=0.605 and α=0.658, respectively). Corrected item-total correlations ranged from 0.224 to 0.638.

Table 15. Internal consistency and item statistics of the Early Life Impact scale (152)

FACE-Q™ Early Life Impact - items	Group 1. (undergone, n=210)			
	Factor 1 Cronbach's alpha (if item removed)	Factor 2 Cronbach's alpha (if item removed)	Factor 3 Cronbach's alpha (if item removed)	Discrimination (corrected item-total correlation)
Item 1 - Regret	-	0.557	-	0.323
Item 2 - Anxious	-	0.547	-	0.366
Item 3 - Sleeping	-	0.556	-	0.382
Item 4 - Worthwhile	-	0.517	-	0.348
Item 5 - Tired	-	-	-	0.224
Item 6 - Head movements	-	-	0.626	0.287
Item 7 - Usual activities	-	-	0.628	0.544
Item 8 - Facial movements	-	-	0.482	0.477
Item 9 - Drinking	0.684	-	-	0.591
Item 10 - Eating	0.719	-	-	0.587
Item 11 – Social situations	0.717	0.573	-	0.638
Item 12 - Intimacy	0.651	-	0.609	0.626
Scale	0.754	0.605	0.658	-

In contrast, the Aging Appraisal and Appearance Distress scales demonstrated excellent internal consistency across the total sample and subgroups (α=0.913–0.926). Corrected item-total correlations ranged from 0.546 to 0.899 (Table 16).

Table 16. Internal consistency and item statistics of the Aging Appraisal and Appearance Distress scales (152)

	Total sample (n=357)		Group 1. (undergone, n=210)		Group 2. (planning, n=147)	
	Cronbach's alpha (if item removed)	Discrimination (corrected item-total correlation)	Cronbach's alpha (if item removed)	Discrimination (corrected item-total correlation)	Cronbach's alpha (if item removed)	Discrimination (corrected item-total correlation)
FACE-Q™ Aging Appraisal - items						
Item 1 – Don't recognize	0.916	0.741	0.911	0.709	0.914	0.760
Item 2 – Look in mirror	0.919	0.688	0.907	0.739	0.928	0.608
Item 3 - Bothered	0.901	0.862	0.894	0.832	0.900	0.890
Item 4 - Older	0.907	0.797	0.901	0.758	0.906	0.831
Item 5 - Worried	0.911	0.768	0.902	0.764	0.912	0.772
Item 6 - Photos	0.903	0.838	0.895	0.818	0.904	0.848
Item 7 - Reflection	0.900	0.863	0.890	0.858	0.901	0.867

	Total sample (n=357)		Group 1. (undergone, n=210)		Group 2. (planning, n=147)	
	Cronbach's alpha (if item removed)	**Discrimination (corrected item-total correlation)**	**Cronbach's alpha (if item removed)**	**Discrimination (corrected item-total correlation)**	**Cronbach's alpha (if item removed)**	**Discrimination (corrected item-total correlation)**
Scale	0.920	-	0.913	-	0.922	-
FACE-Q™ Appearance Distress - items						
Item 1 – Feel unhappy	0.912	0.840	0.904	0.810	0.911	0.863
Item 2 – Feel stressed	0.913	0.821	0.905	0.811	0.914	0.820
Item 3 – Feel down	0.911	0.845	0.902	0.846	0.913	0.833
Item 4 – Feel anxious	0.908	0.875	0.901	0.849	0.907	0.899
Item 5 – Look normal	0.918	0.748	0.911	0.730	0.918	0.753
Item 6 - Ugly	0.912	0.822	0.905	0.797	0.912	0.835
Item 7 – Avoid people	0.921	0.727	0.912	0.727	0.922	0.713
Item 8 – Doing things	0.931	0.559	0.923	0.548	0.933	0.546
Scale	0.926	-	0.919	-	0.926	-

4.2.9 Known-groups validity

As hypothesized, participants who had undergone MICPs reported significantly more favorable outcomes on the FACE-Q scales than those planning MICPs (Table 17). Similarly, participants with higher self-esteem (RSES≥15) also scored significantly better on all FACE-Q scales and felt younger, while those with greater fear of negative evaluation (BFNE-S≥25) had significantly lower scores across all FACE-Q scales and, on average, perceived themselves as looking older. Scores on all four FACE-Q scales also increased with higher levels of acceptance of bodily appearance. Based on effect sizes, the Appearance Distress Scale showed three large and one small effect, followed by the Aging Appraisal Scale and Age VAS (each showing one large, two medium, and one small), while the Early Life Impact Scale showed one medium and two small effects.

Table 17. Known-groups validity of four FACE-Q scales (152)

	n (%) ('undergone' sample)	FACE-Q Early Life Impact			n (%) (pooled sample)	FACE-Q Aging Appraisal			FACE-Q Appearance Distress			FACE-Q Age VAS		
		Mean (SD)	p-value [a]	Effect size [b]		Mean (SD)	p-value [a]	Effect size [b]	Mean (SD)	p-value [a]	Effect size [b]	Mean (SD)	p-value [a]	Effect size [b]
Subgroups														
Group 1. (undergone)	210 (100.0%)	75.29 (20.67)	-	-	210 (58.8%)	72.90 (22.02)	<0.001	0.427	77.13 (21.01)	<0.001	0.405	-4.97 (5.31)	<0.001	0.219
Group 2. (planning)	-	-			147 (41.2%)	63.26 (23.48)			68.44 (22.19)			-2.81 (5.60)		
Total score on the Rosenberg Self-Esteem Scale (RSES)														
Less than 15	22 (10.5%)	66.37 (18.32)	0.025	0.488	60 (16.8%)	57.06 (25.32)	<0.001	0.636	46.16 (17.42)	<0.001	1.822	-0.42 (4.98)	<0.001	0.653
At least 15	188 (89.5%)	76.34 (20.72)			297 (83.2%)	71.33 (21.90)			79.09 (18.26)			-4.78 (5.35)		
Total score on the Brief Fear of Negative Evaluation Scale-Straightforward Items (BFNE-S)														
<25	176 (83.8%)	76.80 (20.0)	0.031	0.459	279 (78.2%)	72.2 (21.6)	<0.001	0.670	80.51 (16.8)	<0.001	1.825	-4.94 (5.21)	<0.001	0.773
≥25	34 (16.2%)	67.57 (22.8)			78 (21.8%)	57.3 (24.5)			48.65 (19.7)			-0.88 (5.52)		
Are you able to accept your bodily appearance?														
Not at all	10 (4.8%)	64.73 (28.90)	0.010	0.062	16 (4.5%)	44.43 (22.98)	<0.001	0.179	34.63 (23.52)	<0.001	0.513	-0.33 (7.50)	<0.001	0.213
A little	9 (4.3%)	60.71 (14.79)			31 (8.7%)	51.45 (23.71)			46.85 (12.57)			2.41 (3.53)		
Moderately	38 (18.1%)	69.69 (19.39)			81 (22.7%)	65.09 (23.77)			62.54 (16.38)			-3.03 (4.75)		
Mostly	35 (16.7%)	78.22 (20.59)			183 (51.3%)	71.61 (20.33)			80.93 (15.81)			-5.11 (5.13)		
Completely	118 (56.2%)	78.27 (17.99)			46 (12.9%)	85.32 (15.47)			95.09 (8.43)			-7.4 (4.05)		

The FACE-Q Early Life Impact scale was completed only by participants in the 'undergone' group (n=210), while the other scales were administered across the pooled sample (n=357). a – Difference in mean scores between groups was tested by independent-sample's t-test (two categories) or analysis of variance (three or more categories). b – Effect sizes were calculated using Cohen's d (two categories) or η^2 (three or more categories).

5 Discussion

5.1 Bolt-on study

The objective of this study was to evaluate the psychometric properties of the EQ-5D-5L descriptive system and five bolt-ons in individuals undergoing and planning MICPs. The EQ-5D-5L showed a marked ceiling effect, with almost half of the participants reporting full health. At the same time, many of these respondents reported problems on at least one bolt-on dimension, suggesting that relevant aspects of HRQoL may not be fully captured by the core EQ-5D-5L dimensions alone. The addition of bolt-ons reduced ceiling effects and improved the instrument's measurement properties, including informativity, explanatory power for EQ VAS scores, and known-groups validity. The self-confidence and social relationships bolt-ons were also supported by their associations with established measures of self-esteem and fear of negative evaluation. Of the five bolt-ons examined, tiredness and self-confidence appeared to provide the greatest benefit, while skin irritation contributed less additional information.

A recent study assessed the psychometric performance of nine existing bolt-ons (including all five tested in the present study) for the EQ-5D-5L in a large general population sample in Hungary (121). Compared with the general population, women undergoing or planning MICPs reported problems more frequently across most bolt-on dimensions, particularly self-confidence. In contrast, the prevalence of skin irritation was similar in the two populations. These findings further support the relevance of the self-confidence bolt-on in this population. However, this comparison should be interpreted with caution, as the general population data were collected during the COVID-19 pandemic, which may have influenced psychosocial well-being.

Similarly to the abovementioned general population survey, the strongest correlation among all the bolt-ons and EQ-5D-5L core dimensions was found between the self-confidence bolt-on and anxiety/depression dimension (121). This can be explained by the association of low self-confidence and mental illnesses such as anxiety and depression (153). Nevertheless, qualitative studies (interviews and focus groups with psoriasis and atopic dermatitis patients) confirmed that self-confidence and anxiety/depression are conceptually different, and the self-confidence bolt-on extends the content covered by the core descriptive system (71,73). Our study demonstrated that the self-confidence bolt-on

enhanced the psychometric performance of the EQ-5D-5L more effectively than the social relationships bolt-on. Notably, when the self-confidence bolt-on was developed in psoriasis patients, the research team also developed a slightly different social relationships bolt-on from the one used in this study. This version had a dimension title of 'social or relationship difficulties' with examples including 'embarrassment' and 'relationship problems'. However, in pursuit of a more parsimonious descriptive system, the team discarded the social relationships bolt-on. This decision was based on the fact that social relationships and self-confidence loaded on the same factor in the exploratory factor analysis, and self-confidence emerged as a more important predictor of variance in the measure (70). Our findings support these results as the moderate correlation (0.462) between these two bolt-ons indicates that they measure similar constructs. However, the social relationships bolt-on appears to cover a broader range. According to the cognitive debriefing interviews of the development study, the social relationships bolt-on may address self-confidence as well as issues related to social interaction, such as feelings of embarrassment or disgust and discomfort with physical intimacy (154).

The popularity of MICPs is increasing, and the demand for them is growing (155). Moreover, the population in developed countries is aging rapidly (156). As MICPs are usually self-funded, it is important to capture the benefits most relevant to this population. The present findings suggest that EQ-5D-5L bolt-ons may improve the assessment of psychosocial aspects of HRQoL that are not fully reflected in the core instrument. Although utility values were not examined, previous studies have shown that bolt-ons can influence health preferences (70,124). Thus, incorporating selected bolt-ons into the EQ-5D-5L has the potential to improve the outcomes of cost-utility analyses for MICPs, thereby better demonstrating the value of these interventions.

Several limitations should be considered when interpreting the findings. The use of convenience sampling and the inclusion of only female participants may limit the representativeness and generalizability of the results. In addition, data were collected through a self-administered online survey, and clinical information was based on self-report. The fixed order of the questionnaires may also have introduced an order effect. Finally, the cross-sectional design did not allow the assessment of responsiveness or test–retest reliability. Future studies should examine these psychometric properties and investigate the impact of bolt-ons on utility values.

5.2 FACE-Q study

In this study, we provided initial support for validity and reliability of four FACE-Q Aesthetics scales (Aging Appraisal, Appearance Distress, Early Life Impact, and the Age VAS) among Hungarian women planning and undergoing MICPs. Despite small ceiling effects in three of the four scales, all scales demonstrated acceptable psychometric performance, with strong evidence for construct and known-groups validity, particularly for the Appearance Distress scale.

The similar sociodemographic characteristics of the planning and undergone groups made it possible to compare their outcomes directly. Women who had undergone MICPs reported lower psychosocial distress, more positive views on aging, and a younger perceived age than those planning treatment. These results are in line with previous studies showing that achieving a more youthful appearance is an important reason for seeking aesthetic procedures (4,5) and that such changes may be associated with improvements in HRQoL and self-esteem (9).

A particular strength of our study is the combined use of the EQ-5D-5L and FACE-Q Aesthetics in the same survey, which has not been investigated before. In terms of construct validity, correlations with most EQ-5D-5L dimensions were weak, underscoring the limited sensitivity of generic HRQoL instruments in capturing the specific effects of MICPs. By contrast, the Appearance Distress scale correlated moderately with the EQ-5D-5L anxiety/depression dimension and the EQ VAS, and strongly with both the RSES and BFNE-S. This pattern highlights the conceptual overlap between appearance-related distress and broader psychosocial problems such as self-esteem, fear of negative evaluation, anxiety, and depression (157–160). This may have important clinical implications, as appearance-related distress can persist despite objectively successful treatment outcomes. Similar observations have been made in skin cancer populations, where pre-existing anxiety and depression were associated with higher levels of postoperative psychosocial distress (161).

The structural validity analyses largely confirmed the original scale factor structures, with the Aging Appraisal and Appearance Distress scales demonstrating clear unidimensionality. For the Early Life Impact scale, PCA yielded a four-factor solution rather than a single factor, while CFA supported a three-factor model (excluding the two-item factor). The factors captured domains of social and functional difficulties, post-

procedure regret and anxiety, and movement-related limitations. This divergence may reflect differences in the nature of MICPs compared to surgical procedures (such as facelift surgery and minimally invasive lip treatments) studied in earlier validation studies (97), and may also suggest cultural variation in how Hungarian patients conceptualize post-treatment impacts, with a clearer distinction between social and physical domains of experience.

The validated Hungarian FACE-Q scales may be useful in both pre-treatment assessment and follow-up. They can provide information on patient expectations, psychosocial well-being, and treatment-related outcomes from the patient's perspective (99). The availability of validated Hungarian FACE-Q scales enables standardized outcome measurement in research and supports cross-national comparisons.

This study has several limitations. First, convenience sampling and inclusion of only women may limit the representativeness of the sample, reducing generalizability to men, older adults, or other demographic subgroups. Second, data were collected via a self-administered online survey, relying on self-reported clinical information that was not verified by physicians. Third, the fixed order of standardized questionnaires may have introduced order effects. In addition, content validity assessment was limited to cognitive debriefing after translation and was conducted in a relatively small sample. The use of different recall periods across the scales may also have affected responses. Finally, the study’s cross-sectional design precluded the assessment of responsiveness and test–retest reliability.

6 Conclusions

6.1 Bolt-on study

Our findings suggest that relevant bolt-ons can improve the psychometric performance of the EQ-5D-5L in women planning or undergoing MICPs, including reductions in ceiling effects and improvements in informativity and known-groups validity. Among the evaluated bolt-ons, self-confidence and tiredness showed the most favorable overall performance and appear to be the most relevant bolt-ons for this population.

6.2 FACE-Q study

Our study provides the first comprehensive psychometric assessment of four FACE-Q Aesthetics HRQoL scales in the context of facial MICPs, supporting their preliminary use in both clinical and research settings. The different factor structure of the Early Life Impact scale warrants further investigation in diverse populations. Routine use of FACE-Q could enhance patient-centered care in cosmetic dermatology and contribute to a more nuanced understanding of psychosocial outcomes of MICPs.

7 Summary

This thesis investigated the measurement of HRQoL in women planning or undergoing MICPs. The work focused on both generic and condition-specific HRQoL instruments and consisted of two empirical studies based on a cross-sectional data collection in Hungary in 2023. The first study evaluated the psychometric performance of five previously developed bolt-on dimensions added to the EQ-5D-5L. The EQ-5D-5L showed substantial ceiling effects in this population. The inclusion of bolt-ons reduced ceiling effects and improved informativity, explanatory power and known-groups validity. Among the evaluated bolt-ons, self-confidence and tiredness demonstrated the most favorable overall performance and appeared particularly relevant for this population. The second part of the thesis involved the translation, cultural adaptation, and psychometric evaluation of four FACE-Q Aesthetics HRQoL scales (Aging Appraisal, Appearance Distress, Early Life Impact and Age VAS). The Hungarian versions demonstrated acceptable psychometric performance. The Aging Appraisal and Appearance Distress scales showed clear unidimensionality, excellent internal consistency, and good construct and known-groups validity. The Early Life Impact Scale demonstrated a different factor structure, suggesting that further evaluation in other populations may be warranted. The two studies together provide information on the assessment of HRQoL in women planning or undergoing MICPs. The findings also highlight the importance of appearance-related and psychosocial aspects of HRQoL that may not be adequately captured by generic instruments alone. Further research is needed to examine these instruments in other populations and settings and to evaluate additional psychometric properties, including responsiveness and test–retest reliability. As a result of our research, a set of generic and condition-specific questionnaires is available in Hungarian to assess the therapeutic benefits of treatments.

8 References

1. American Society of Plastic Surgeons. 2024 ASPS procedural statistics release [Internet]. 2025 [cited 2026 Sep 8]. Available from: https://www.plasticsurgery.org/documents/news/statistics/2024/plastic-surgery-statistics-report-2024.pdf
2. Devgan L, Singh P, Durairaj K. Minimally invasive facial cosmetic procedures. Otolaryngol Clin North Am. 2019;52(3):443–59.
3. Chuang J, Barnes C, Wong BJF. Overview of facial plastic surgery and current developments. Surg J (N Y). 2016;2(1):e17–28.
4. Waldman A, Maisel A, Weil A, Iyengar S, Sacotte K, Lazaroff JM, et al. Patients believe that cosmetic procedures affect their quality of life: an interview study of patient-reported motivations. J Am Acad Dermatol. 2019;80(6):1671–81.
5. Maisel A, Waldman A, Furlan K, Weil A, Sacotte K, Lazaroff JM, et al. Self-reported patient motivations for seeking cosmetic procedures. JAMA Dermatol. 2018;154(10):1167–74.
6. Barbeito de Vasconcellos J, Alves Pereira Antelo D, Orofino-Costa R. Impact on the quality of life following minimally invasive cosmetic procedures: assessment through the Skin Rejuvenation Outcome Evaluation Questionnaire. Dermatol Surg. 2022;48(10):1092–6.
7. Hoffman L, Fabi S. Look better, feel better, live better? The impact of minimally invasive aesthetic procedures on satisfaction with appearance and psychosocial wellbeing. J Clin Aesthet Dermatol. 2022;15(5):47–58.
8. Azadeh Mafi N, Nahidi Y, Layegh P, Khadem Rezayian M, Nahidi M. Quality of life, body image and personality traits among women receiving botulinum toxin type A for cosmetic purposes. Aesthetic Plast Surg. 2023;47(4):1542–9.
9. Aquino MS, Haddad A, Ferreira LM. Assessment of quality of life in patients who underwent minimally invasive cosmetic procedures. Aesthetic Plast Surg. 2013;37(3):497–503.
10. Sobanko JF, Dai J, Gelfand JM, Sarwer DB, Percec I. Prospective cohort study investigating changes in body image, quality of life, and self-esteem following minimally invasive cosmetic procedures. Dermatol Surg. 2018;44(8):1121–8.
11. Hemsworth B, Hemsworth C, Richmond SA. Nonsurgical medical aesthetics and patient quality of life: an umbrella review. Aesthet Surg J Open Forum. 2024;6:ojae096.
12. Sandman L, Hansson E. An ethics analysis of the rationale for publicly funded plastic surgery. BMC Med Ethics. 2020;21:94.
13. Ogden S, Griffiths T. A review of minimally invasive cosmetic procedures. Br J Dermatol. 2008;159(5):1036–50.
14. Rashid Y, Estela-Fernandez C, Sardar A, Deowan D, Safdar OM, Issimdar IA, et al. Advances in anti-aging procedures: a comprehensive review of surgical and non-surgical rejuvenation techniques. Cureus. 2025;17(9):e92666.

15. Holland E. Marquardt's Phi Mask: pitfalls of relying on fashion models and the golden ratio to describe a beautiful face. Aesthetic Plast Surg. 2008;32(2):200–8.
16. Ballin AC, Brandt FS, Cazzaniga A. Dermal fillers: an update. Am J Clin Dermatol. 2015;16(4):271–83.
17. Kapoor KM, Kapoor P, Heydenrych I, Bertossi D. Vision loss associated with hyaluronic acid fillers: a systematic review of literature. Aesthetic Plast Surg. 2020;44(3):929–44.
18. King M, Walker L, Convery C, Davies E. Management of a vascular occlusion associated with cosmetic injections. J Clin Aesthet Dermatol. 2020;13(1):E53–8.
19. Doyon VC, Liu C, Fitzgerald R, Humphrey S, Jones D, Carruthers JDA, et al. Update on blindness from filler: review of prognostic factors, management approaches, and a century of published cases. Aesthet Surg J. 2024;44(10):1091–104.
20. Dutta SR, Passi D, Singh M, Singh P, Sharma S, Sharma A. Botulinum toxin the poison that heals: a brief review. Natl J Maxillofac Surg. 2016;7(1):10–6.
21. Monash A, Tam J, Rosen O, Soreq H. Botulinum neurotoxins: history, mechanism, and applications. A narrative review. J Neurochem. 2025;169(8):e70187.
22. Ayoub N. Botulinum toxin therapy: a comprehensive review on clinical and pharmacological insights. J Clin Med. 2025;14(6):2021.
23. Sethi N, Singh S, DeBoulle K, Rahman E. A review of complications due to the use of botulinum toxin A for cosmetic indications. Aesthetic Plast Surg. 2021;45(3):1210–20.
24. Gupta AK, Polla Ravi S, Wang T, Talukder M, Starace M, Piraccini BM. Systematic review of mesotherapy: a novel avenue for the treatment of hair loss. J Dermatolog Treat. 2023;34(1):2245084.
25. Kandhari R, Kaur I, Sharma D. Mesococktails and mesoproducts in aesthetic dermatology. Dermatol Ther. 2020;33(6):e14218.
26. Plachouri KM, Georgiou S. Mesotherapy: safety profile and management of complications. J Cosmet Dermatol. 2019;18(6):1601–5.
27. Tamura T, Okumura K, Funakoshi Y, Teranishi H. Multicenter review of more than 110,000 facial thread lifting cases from a cosmetic surgery group. Plast Reconstr Surg Glob Open. 2025;13(12):e7335.
28. Hong GW, Kim SB, Park SY, Wan J, Yi KH. Thread lifting materials: a review of its difference in terms of technical and mechanical perspective. Clin Cosmet Investig Dermatol. 2024;17:999–1006.
29. Li YL, Li ZH, Chen XY, Xing WS, Hu JT. Facial thread lifting complications in China: analysis and treatment. Plast Reconstr Surg Glob Open. 2021;9(9):e3820.
30. Preissig J, Hamilton K, Markus R. Current laser resurfacing technologies: a review that delves beneath the surface. Semin Plast Surg. 2012;26(3):109–16.

31. Manstein D, Herron GS, Sink RK, Tanner H, Anderson RR. Fractional photothermolysis: a new concept for cutaneous remodeling using microscopic patterns of thermal injury. Lasers Surg Med. 2004;34(5):426–38.

32. Liu F, Zhou Q, Tao M, Shu L, Cao Y. Efficacy and safety of CO2 fractional laser versus Er:YAG fractional laser in the treatment of atrophic acne scar: a meta-analysis and systematic review. J Cosmet Dermatol. 2024;23(9):2768–78.

33. Kang BY, Cohen JL, Geronemus R, Kilmer SL, Ross EV, Tanzi EL, et al. Consensus statement on the prevention and management of complications of fully ablative laser resurfacing of the face. Lasers Surg Med. 2025;57(6):477–89.

34. Landau M, Bageorgeou F. Update on chemical peels. Dermatol Clin. 2024;42(1):13–20.

35. Lee KC, Wambier CG, Soon SL, Sterling JB, Landau M, Rullan P, et al. Basic chemical peeling: superficial and medium-depth peels. J Am Acad Dermatol. 2019;81(2):313–24.

36. Fischer TC, Perosino E, Poli F, Viera MS, Dreno B, Cosmetic Dermatology European Expert Group. Chemical peels in aesthetic dermatology: an update 2009. J Eur Acad Dermatol Venereol. 2010;24(3):281–92.

37. Costa IMC, Damasceno PS, Costa MC, Gomes KGP. Review in peeling complications. J Cosmet Dermatol. 2017;16(3):319–26.

38. Dhurat R, Sukesh M. Principles and methods of preparation of platelet-rich plasma: a review and author's perspective. J Cutan Aesthet Surg. 2014;7(4):189–97.

39. Hesseler MJ, Shyam N. Platelet-rich plasma and its utility in medical dermatology: a systematic review. J Am Acad Dermatol. 2019;81(3):834–46.

40. Pixley JN, Cook MK, Singh R, Larrondo J, McMichael AJ. A comprehensive review of platelet-rich plasma for the treatment of dermatologic disorders. J Dermatolog Treat. 2023;34(1):2142035.

41. Asubiaro J, Avajah F. Platelet-rich plasma in aesthetic dermatology: current evidence and future directions. Cureus. 2024;16(8):e66734.

42. Karam EZ, Gan A, Muci Mendoza R, Martinez E, Perez E. Visual loss after platelet-rich plasma injection into the face. Neuroophthalmology. 2020;44(6):371–8.

43. Haraldstad K, Wahl A, Andenæs R, Andersen JR, Andersen MH, Beisland E, et al. A systematic review of quality of life research in medicine and health sciences. Qual Life Res. 2019;28(10):2641–50.

44. Constitution of the World Health Organization. Chron World Health Organ. 1947;1(1-2):29–43.

45. Karimi M, Brazier J. Health, health-related quality of life, and quality of life: what is the difference? Pharmacoeconomics. 2016;34(7):645–9.

46. Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. Psychol Med. 1998;28(3):551–8.

47. Felce D, Perry J. Quality of life: its definition and measurement. Res Dev Disabil. 1995;16(1):51–74.

48. Kaplan RM, Bush JW. Health-related quality of life measurement for evaluation research and policy analysis. Health Psychol. 1982;1(1):61–80.

49. Black N. Patient reported outcome measures could help transform healthcare. BMJ. 2013;346:f167.

50. Mercieca-Bebber R, King MT, Calvert MJ, Stockler MR, Friedlander M. The importance of patient-reported outcomes in clinical trials and strategies for future optimization. Patient Relat Outcome Meas. 2018;9:353–67.

51. Franklin P, Chenok K, Lavalee D, Love R, Paxton L, Segal C, et al. Framework to guide the collection and use of patient-reported outcome measures in the learning healthcare system. EGEMS (Wash DC). 2017;5(1):17.

52. Murray CJ, Frenk J. A framework for assessing the performance of health systems. Bull World Health Organ. 2000;78(6):717–31.

53. Fung CH, Hays RD. Prospects and challenges in using patient-reported outcomes in clinical practice. Qual Life Res. 2008;17(10):1297–302.

54. Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. Ann Intern Med. 1993;118(8):622–9.

55. Brazier J, Ara R, Azzabi I, Busschbach J, Chevrou-Séverac H, Crawford B, et al. Identification, review, and use of health state utilities in cost-effectiveness models: an ISPOR good practices for outcomes research task force report. Value Health. 2019;22(3):267–75.

56. 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.

57. Sharma D, Aggarwal AK, Downey LE, Prinja S. National healthcare economic evaluation guidelines: a cross-country comparison. Pharmacoecon Open. 2021;5(3):349–64.

58. Ades AE, Lu G, Madan JJ. Which health-related quality-of-life outcome when planning randomized trials: disease-specific or generic, or both? A common factor model. Value Health. 2013;16(1):185–94.

59. Kennedy-Martin M, Slaap B, Herdman M, 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.

60. 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.

61. A Belügyminisztérium egészségügyi szakmai irányelve az egészség-gazdaságtani elemzések készítéséhez és értékeléséhez. Egészségügyi Közlöny. 2025;75(9):1250–75.

62. Rabin R, Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001;33(5):337–43.

63. 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.

64. 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.

65. 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.

66. 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.

67. Shah KK, Mulhern B, Longworth L, Janssen MF. Views of the UK general public on important aspects of health not captured by EQ-5D. Patient. 2017;10(6):701–9.

68. 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.

69. Geraerds AJLM, 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.

70. Swinburn P, Lloyd A, Boye KS, Edson-Heredia E, Bowman L, Janssen B. Development of a disease-specific version of the EQ-5D-5L for use in patients suffering from psoriasis: lessons learned from a feasibility study in the UK. Value Health. 2013;16(8):1156–62.

71. 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.

72. Pickard AS, Gooderham M, Hartz S, Nicolay C. EQ-5D health utilities: exploring ways to improve upon responsiveness in psoriasis. J Med Econ. 2017;20(1):19–27.

73. Szlávicz E, Szabó Á, Kinyó Á, Szeiffert A, Bancsók T, Brodszky V, et al. Content validity of the EQ-5D-5L with skin irritation and self-confidence bolt-ons in patients with atopic dermatitis: a qualitative think-aloud study. Qual Life Res. 2024;33(1):101–11.

74. Metyovinyi Z, Plázár D, Becker K, Medvecz M, Rencz F. Qualitative testing of the EQ-HWB-9 with a 'blank' EQ-HWB VAS and EQ-5D-5L with skin bolt-ons in a rare genetic skin disease population. Qual Life Res. 2026;35(3):69.

75. Plázár D, Metyovinyi Z, Medvecz M, Rencz F. Qualitative evidence on EQ-5D-5L skin irritation and self-confidence bolt-ons in Darier's disease and Hailey-Hailey disease. Qual Life Res. 2025;34(4):977–89.

76. Klassen AF, Cano SJ, Scott A, Snell L, Pusic AL. Measuring patient-reported outcomes in facial aesthetic patients: development of the FACE-Q. Facial Plast Surg. 2010;26(4):303–9.

77. Kosowski TR, McCarthy C, Reavey PL, Scott AM, Wilkins EG, Cano SJ, et al. A systematic review of patient-reported outcome measures after facial cosmetic surgery and/or nonsurgical facial rejuvenation. Plast Reconstr Surg. 2009;123(6):1819–27.

78. Imadojemu S, Sarwer DB, Percec I, Sonnad SS, Goldsack JE, Berman M, et al. Influence of surgical and minimally invasive facial cosmetic procedures on psychosocial outcomes: a systematic review. JAMA Dermatol. 2013;149(11):1325–33.

79. Rauch S, De Simone P, Bertucci V. Applicability of patient-reported outcome measures to aesthetic medicine patient archetypes. Dermatol Surg. 2024;50(1):86–92.

80. Pompilus F, Burgess S, Hudgens S, Banderas B, Daniels S. Development and validation of a novel patient-reported treatment satisfaction measure for hyperfunctional facial lines: facial line satisfaction questionnaire. J Cosmet Dermatol. 2015;14(4):274–85.

81. Yaworsky A, Daniels S, Tully S, Beddingfield F 3rd, Kowalski J, Fitzgerald K, et al. The impact of upper facial lines and psychological impact of crow's feet lines: content validation of the Facial Line Outcomes (FLO-11) Questionnaire. J Cosmet Dermatol. 2014;13(4):297–306.

82. Cox SE, Finn JC, Stetler L, Mackowiak J, Kowalski JW. Development of the Facial Lines Treatment Satisfaction Questionnaire and initial results for botulinum toxin type A-treated patients. Dermatol Surg. 2003;29(5):444–9; discussion 449.

83. Carruthers A, Carruthers J. Patient-reported outcomes with botulinum neurotoxin type A. J Cosmet Laser Ther. 2007;9 Suppl 1:32–7.

84. 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.

85. Vyas J, Johns JR, Ali FM, Singh RK, Ingram JR, Salek S, et al. A systematic review of 454 randomized controlled trials using the Dermatology Life Quality Index: experience in 69 diseases and 43 countries. Br J Dermatol. 2024;190(3):315–39.

86. Rencz F, Gulácsi L, Péntek M, Szegedi A, Remenyik É, Bata-Csörgő Z, et al. DLQI-R scoring improves the discriminatory power of the Dermatology Life Quality Index in patients with psoriasis, pemphigus and morphea. Br J Dermatol. 2020;182(5):1167–75.

87. Rencz F, Gulácsi L, Péntek M, Poór AK, Sárdy M, Holló P, et al. Proposal of a new scoring formula for the Dermatology Life Quality Index in psoriasis. Br J Dermatol. 2018;179(5):1102–8.

88. Chren MM, Lasek RJ, Quinn LM, Mostow EN, Zyzanski SJ. Skindex, a quality-of-life measure for patients with skin disease: reliability, validity, and responsiveness. J Invest Dermatol. 1996;107(5):707–13.

89. Nijsten TEC, Sampogna F, Chren MM, Abeni DD. Testing and reducing Skindex-29 using Rasch analysis: Skindex-17. J Invest Dermatol. 2006;126(6):1244–50.

90. Swerlick RA, Zhang C, Patel A, Chren MM, Chen S. The Skindex-Mini: a streamlined quality of life measurement tool suitable for routine use in clinic. J Am Acad Dermatol. 2021;85(2):510–2.

91. Aaronson N, Alonso J, Burnam A, Lohr K, Patrick D, Perrin E, et al. Assessing health status and quality-of-life instruments: attributes and review criteria. Qual Life Res. 2002;11(3):193–205.

92. U.S. Department of Health and Human Services FDA Center for Drug Evaluation and Research, U.S. Department of Health and Human Services FDA Center for Biologics Evaluation and Research, U.S. Department of Health and Human Services FDA Center for Devices and Radiological Health. Guidance for industry: patient-reported outcome measures: use in medical product development to support labeling claims: draft guidance. Health Qual Life Outcomes. 2006;4:79.

93. Pusic AL, Klassen AF, Scott AM, Cano SJ. Development and psychometric evaluation of the FACE-Q satisfaction with appearance scale: a new patient-reported outcome instrument for facial aesthetics patients. Clin Plast Surg. 2013;40(2):249–60.

94. Klassen AF, Pusic AL, Cano SJ. FACE-Q aesthetics: a user's guide for researchers and clinicians [Internet]. 2025 [cited 2026 Sep 2]. Available from: https://qportfolio.org/wp-content/uploads/2025/04/FACE-Q-AESTHETICS-USERS-GUIDE.pdf

95. Panchapakesan V, Klassen AF, Cano SJ, Scott AM, Pusic AL. Development and psychometric evaluation of the FACE-Q Aging Appraisal Scale and Patient-Perceived Age Visual Analog Scale. Aesthet Surg J. 2013;33(8):1099–109.

96. Klassen AF, Cano SJ, Scott AM, Pusic AL. Measuring outcomes that matter to face-lift patients: development and validation of FACE-Q appearance appraisal scales and adverse effects checklist for the lower face and neck. Plast Reconstr Surg. 2014;133(1):21–30.

97. Klassen AF, Cano SJ, Schwitzer JA, Scott AM, Pusic AL. FACE-Q scales for health-related quality of life, early life impact, satisfaction with outcomes, and decision to have treatment: development and validation. Plast Reconstr Surg. 2015;135(2):375–86.

98. Klassen AF, Cano SJ, East CA, Baker SB, Badia L, Schwitzer JA, et al. Development and psychometric evaluation of the FACE-Q scales for patients undergoing rhinoplasty. JAMA Facial Plast Surg. 2016;18(1):27–35.

99. Klassen AF, Cano SJ, Alderman A, East C, Badia L, Baker SB, et al. Self-report scales to measure expectations and appearance-related psychosocial distress in patients seeking cosmetic treatments. Aesthet Surg J. 2016;36(9):1068–78.

100. Klassen AF, Cano SJ, Schwitzer JA, Baker SB, Carruthers A, Carruthers J, et al. Development and psychometric validation of the FACE-Q skin, lips, and facial rhytids appearance scales and adverse effects checklists for cosmetic procedures. JAMA Dermatol. 2016;152(4):443–51.

101. Klassen AF, Cano SJ, Grotting JC, Baker SB, Carruthers J, Carruthers A, et al. FACE-Q eye module for measuring patient-reported outcomes following cosmetic eye treatments. JAMA Facial Plast Surg. 2017;19(1):7–14.

102. Schwitzer JA, Klassen AF, Cano SJ, Baker SB, East C, Pusic AL. Measuring satisfaction with appearance: validation of the FACE-Q scales for the nose, forehead, cheekbones, and chin. Plast Reconstr Surg. 2015;136(4S):140–1.

103. Gallo L, Kim P, Churchill IF, Gallo M, Yuan M, Voineskos SH, et al. Measuring the impact of surgical and non-surgical facial cosmetic interventions using FACE-Q aesthetic module scales: a systematic review and meta-analysis. Plast Surg (Oakv). 2024 Jan 23;33(3):403–18.

104. Ottenhof MJ, Veldhuizen IJ, Hensbergen LJV, Blankensteijn LL, Bramer W, Lei BV, et al. The use of the FACE-Q Aesthetic: a narrative review. Aesthetic Plast Surg. 2022;46(6):2769–80.

105. Ascher B, Rzany B, Kestemont P, Hilton S, Heckmann M, Bodokh I, et al. Significantly increased patient satisfaction following liquid formulation abobotulinumtoxinA treatment in glabellar lines: FACE-Q outcomes from a phase 3 clinical trial. Aesthet Surg J. 2020;40(9):1000–8.

106. Homsy SP, Repo JP, Lindford AJ, Uimonen MM, Lassus P. Validation of the Finnish FACE-Q for use in patients undergoing surgery for functional problems or malignancy. J Plast Surg Hand Surg. 2022;56(5):270–6.

107. Elegbede A, Mermulla S, Diaconu SC, McNichols C, Liang Y, Liang F, et al. Patient-reported outcomes in facial reconstruction: assessment of FACE-Q scales and predictors of satisfaction. Plast Reconstr Surg Glob Open. 2018;6(12):e2004.

108. Gallo L, Kim P, Yuan M, Gallo M, Thoma A, Voineskos SH, et al. Best practices for FACE-Q aesthetics research: a systematic review of study methodology. Aesthet Surg J. 2023;43(9):NP674–86.

109. Ranganathan P, Caduff C, Frampton CMA. Designing and validating a research questionnaire - Part 2. Perspect Clin Res. 2024;15(1):42–5.

110. Terwee CB, Bot SDM, Boer MR, Windt DAWM, 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.

111. Mokkink LB, Elsman EBM, Terwee CB. COSMIN guideline for systematic reviews of patient-reported outcome measures version 2.0. Qual Life Res. 2024;33(11):2929–39.

112. 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.

113. Mokkink LB, Herbelet S, Tuinman PR, Terwee CB. Content validity: judging the relevance, comprehensiveness, and comprehensibility of an outcome measurement instrument – a COSMIN perspective. J Clin Epidemiol. 2025;185:111879.

114. Kirshner B, Guyatt G. A methodological framework for assessing health indices. J Chronic Dis. 1985;38(1):27–36.

115. Guyatt GH, Deyo RA, Charlson M, Levine MN, Mitchell A. Responsiveness and validity in health status measurement: a clarification. J Clin Epidemiol. 1989;42(5):403–8.

116. McHorney CA, Tarlov AR. Individual-patient monitoring in clinical practice: are available health status surveys adequate? Qual Life Res. 1995;4(4):293–307.

117. Lohr KN, Aaronson NK, Alonso J, Burnam MA, Patrick DL, Perrin EB, et al. Evaluating quality-of-life and health status instruments: development of scientific review criteria. Clin Ther. 1996;18(5):979–92.

118. Pearl RL, Percec I. Ageism and health in patients undergoing cosmetic procedures. Aesthet Surg J. 2019;39(7):NP288–92.

119. Haagsma J, et al. POPCORN: longitudinal effects of the COVID-19 pandemic on individuals' health-related quality of life. EQ Project 238-RA; 2021.

120. Dewilde S, Phillips G, Paci S, De Ruyck F, Tollenaar NH, Janssen MF. The burden patients with myasthenia gravis experience in terms of breathing, fatigue, sleep, mental health, discomfort and usual activities in comparison to the general population. Adv Ther. 2024;41(1):271–91.

121. 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.

122. Müller EM, Nikl A, Krebs M, Holló P, Brodszky V, Kemény LV, et al. Psychometric benefits of adding bolt-ons to the EQ-5D-5L in populations undergoing minimally invasive cosmetic procedures. Eur J Health Econ. 2025;26:1233–47.

123. 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.

124. Yang Y, Brazier J, Tsuchiya A. Effect of adding a sleep dimension to the EQ-5D descriptive system: a "bolt-on" experiment. Med Decis Making. 2014;34(1):42–53.

125. Perneger TV, Courvoisier DS. Exploration of health dimensions to be included in multi-attribute health-utility assessment. Int J Qual Health Care. 2011;23(1):52–9.

126. Finch AP, Brazier J, Mukuria C. Selecting bolt-on dimensions for the EQ-5D: testing the impact of hearing, sleep, cognition, energy, and relationships on preferences using pairwise choices. Med Decis Making. 2021;41(1):89–99.

127. Sallay V, Martos T, Földvári M, Szabó T, Ittzés A. A Rosenberg Önértékelés Skála (RSES-H): alternatív fordítás, strukturális invariancia és validitás [Hungarian version of the Rosenberg Self-esteem Scale (RSES-H): an alternative translation, structural invariance, and validity]. Mentálhigiéné és Pszichoszomatika. 2014;15(3):259–75.

128. Rosenberg M. Society and the adolescent self-image. Princeton (NJ): Princeton University Press; 1965.

129. Donnellan MB, Trzesniewski KH, Robins RW. Measures of self-esteem. In: Boyle GJ, Saklofske DH, Matthews G, editors. Measures of personality and social psychological constructs. San Diego: Academic Press; 2015. p. 131–57.

130. Isomaa R, Väänänen JM, Fröjd S, Kaltiala-Heino R, Marttunen M. How low is low? Low self-esteem as an indicator of internalizing psychopathology in adolescence. Health Educ Behav. 2013;40(4):392–9.

131. Perczel-Forintos D, Kresznerits S. [Social anxiety and self-esteem: Hungarian validation of the "Brief Fear of Negative Evaluation Scale - Straightforward Items"]. Orv Hetil. 2017;158(22):843–50.

132. Rodebaugh TL, Woods CM, Thissen DM, Heimberg RG, Chambless DL, Rapee RM. More information from fewer questions: the factor structure and item properties of the original and brief fear of negative evaluation scale. Psychol Assess. 2004;16(2):169–81.

133. Shannon CE. A mathematical theory of communication. Bell Syst Tech J. 1948;27(3):379–423.

134. Janssen MF, 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.

135. Rosenberg M. The association between self-esteem and anxiety. J Psychiatr Res. 1962;1(2):135–52.

136. Angyal M, Janssen MF, Lakatos PL, Brodszky V, Rencz F. PCR225 the added value of the cognition, dining, gastrointestinal problems, sleep, and tiredness bolt-ons for the EQ-5D-5L in patients with coeliac disease. Value Health. 2023;26(12):S492.

137. Evans JD. Straightforward statistics for the behavioral sciences. Pacific Grove (CA): Brooks/Cole Publishing Co; 1996.

138. 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.

139. Wild D, Grove A, Martin M, Eremenco S, McElroy S, Verjee-Lorenz A, et al. Principles of good practice for the translation and cultural adaptation process for

patient-reported outcomes (PRO) measures: report of the ISPOR Task Force for Translation and Cultural Adaptation. Value Health. 2005;8(2):94–104.

140. Kaiser HF, Rice J. Little jiffy, Mark IV. Educ Psychol Meas. 1974;34(1):111–7.

141. Kaiser HF. A second generation little jiffy. Psychometrika. 1970;35(4):401–15.

142. Bartlett MS. Tests of significance in factor analysis. Br J Stat Psychol. 1950;3(2):77–85.

143. Kaiser HF. An index of factorial simplicity. Psychometrika. 1974;39(1):31–6.

144. Tobias S, Carlson JE. Brief report: Bartlett's test of sphericity and chance findings in factor analysis. Multivariate Behav Res. 1969;4(3):375–7.

145. Brown TA. Confirmatory factor analysis for applied research. 2nd ed. New York (NY): The Guilford Press; 2015.

146. Franklin SB, Gibson DJ, Robertson PA, Pohlmann JT, Fralish JS. Parallel analysis: a method for determining significant principal components. J Veg Sci. 1995;6(1):99–106.

147. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. 7th ed. Upper Saddle River (NJ): Pearson; 2010.

148. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Modeling. 1999;6(1):1–55.

149. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika. 1951;16(3):297–334.

150. Nunnally JC, Bernstein IH. Psychometric theory. 3rd ed. New York: McGraw-Hill; 1994.

151. Cohen J. A power primer. Psychol Bull. 1992;112(1):155–9.

152. Müller EM, Nikl A, Krebs M, Szabó Á, Holló P, Brodszky V, et al. Psychometric properties of four FACE-Q Aesthetics scales in patients planning and undergoing minimally invasive facial cosmetic procedures. Qual Life Res. 2026;35(8):201.

153. Sowislo JF, Orth U. Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. Psychol Bull. 2013;139(1):213–40.

154. Lloyd A, Swinburn P, Edson EJ, Bowman L, Secnik-Boye K, Janssen MF, et al. Development of the EQ-5D-Psoriasis. In: Proceedings of the 27th EuroQol Plenary Meeting; 2010 Sep 16–18; Athens, Greece.

155. Wang JV, Akintilo L, Geronemus RG. Growth of cosmetic procedures in millennials: a 4.5-year clinical review. J Cosmet Dermatol. 2020;19(12):3210–2.

156. Cheng X, Yang Y, Schwebel DC, Liu Z, Li L, Cheng P, et al. Population ageing and mortality during 1990–2017: a global decomposition analysis. PLoS Med. 2020;17(6):e1003138.

157. Almudimeegh A, Almukhadeb E, Nagshabandi KN, Alshehri N, Almusa HA, Aldosari O, et al. The impact of individuals' self-esteem on cosmetic dermatology

preferences assessed using the Rosenberg Self-Esteem Scale: a cross-sectional study. Medicine (Baltimore). 2025;104(26):e43109.

158. Chopra D, De La Garza R. Depressive, anxiety, and distress symptoms among cancer patients who endorse appearance problems. Palliat Support Care. 2019;17(3):328–32.

159. Bullen TL, Sharpe L, Lawsin C, Patel DC, Clarke S, Bokey L. Body image as a predictor of psychopathology in surgical patients with colorectal disease. J Psychosom Res. 2012;73(6):459–63.

160. Chang O, Choi EK, Kim IR, Nam SJ, Lee JE, Lee SK, et al. Association between socioeconomic status and altered appearance distress, body image, and quality of life among breast cancer patients. Asian Pac J Cancer Prev. 2014;15(20):8607–12.

161. Vaidya TS, Mori S, Dusza SW, Rossi AM, Nehal KS, Lee EH. Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. Arch Dermatol Res. 2019;311(9):691–6.

9 Bibliography of the candidate's publications

Σ IF: 6.5

9.1 Publications related to this thesis Σ IF: 6.5

Peer-reviewed journal articles

- **Müller EM**, Nikl A, Krebs M, Holló P, Brodszky V, Kemény LV, Rencz F. Psychometric benefits of adding bolt-ons to the EQ-5D-5L in populations undergoing minimally invasive cosmetic procedures. Eur J Health Econ. 2025;26:1233–1247. doi:10.1007/s10198-025-01772-9. **IF: 3.1 (D1)**
- **Müller EM**, Nikl A, Krebs M, Szabó Á, Holló P, Brodszky V, Rencz F, Kemény LV. Psychometric properties of four FACE-Q Aesthetics scales in patients planning and undergoing minimally invasive facial cosmetic procedures. Qual Life Res**.** 2026;35:201. doi:10.1007/s11136-026-04313-w. **IF: 3.4 (Q1)**

9.2 Publications not related to this thesis

Peer-reviewed journal article

- Pokoly B, Fónyad L, **Müller EM**, Bálint PV. Scleroedema diabeticorum – esetismertetés és irodalmi összefoglalás. **Diabetol Hung.** 2023;31(4):295-301. doi:10.24121/dh.2023.19.

10 Acknowledgments

I would like to express my sincere gratitude to Prof. Fanni Rencz, my supervisor, for her invaluable guidance and support throughout my doctoral studies. Her remarkable career, exceptional precision, attention to detail, clarity of thought and humility have always been a source of inspiration to me. I feel truly privileged to work with her.

I am deeply grateful to Dr. Lajos V. Kemény, my co-supervisor, for his continuous support throughout my doctoral studies. His dedication, positive attitude and constant encouragement have meant a great deal to me. Working with Dr. Kemény is always rewarding and inspiring, both in research and in patient care.

I am deeply grateful to Dr. Anna Nikl for her contribution to the statistical analyses. I would like to thank Prof. Valentin Brodszky and Dr. Ákos Szabó from the Department of Health Policy at Corvinus University of Budapest, as well as Dr. Máté Krebs from the Department of Dermatology, Venereology and Dermatooncology at Semmelweis University, for their valuable contributions to the studies presented in this thesis. I would also like to thank all those who participated in the surveys.

I would like to express my gratitude to Prof. Miklós Sárdy, my mentor in dermatology, for giving me the opportunity to begin my dermatology residency and for his exceptional support ever since. I am especially grateful to know that I can always turn to Prof. Sárdy for advice whenever I need it. His dedication, precision and approach to dermatology have greatly shaped my clinical thinking.

I would also like to thank Prof. Péter Holló, Head of the Department of Dermatology, Venereology and Dermatooncology at Semmelweis University. Prof. Holló played an important role in my early clinical training. I learned many of the fundamentals of dermatology from him.

I would also like to express my gratitude to Dr. Beáta Hegedűs, my mentor in cosmetic dermatology, for the opportunity to learn from her and develop my practical skills in cosmetic procedures.

I would also like to thank my senior colleagues at the Department of Dermatology, Venereology and Dermatooncology, whom I can always turn to for advice in my daily clinical practice: Dr. András Bánvölgyi, Dr. Anikó Kovács, Dr. Kende Lőrincz, Dr.

Andrea Lukács, Dr. Judit Hársing, Dr. Anita Mohos, Dr. Enikő Kuroli, Dr. Béla Tóth, Dr. József Szakonyi and Dr. Daniella Kuzmanovszki.

Finally, I would like to thank my former co-residents for making my residency enjoyable: Dr. Luca Fésűs, Dr. Ugur Cakir and Dr. Pálma Anker.

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Appendix 1. Responses on the RSES (122)

Items	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Total sample (n=364)								
Item 1 - On the whole, I am satisfied with myself.	89	24.5	169	46.4	88	24.2	18	4.9
Item 2 - At times I think I am no good at all. *	29	8.0	86	23.6	101	27.7	148	40.7
Item 3 - I feel that I have a number of good qualities.	188	51.6	152	41.8	20	5.5	4	1.1
Item 4 - I am able to do things as well as most other people.	184	50.5	150	41.2	28	7.7	2	0.5
Item 5 - I feel I do not have much to be proud of. *	25	6.9	51	14.0	109	29.9	179	49.2
Item 6 - I certainly feel useless at times. *	34	9.3	105	28.8	110	30.2	115	31.6
Item 7 - I feel that I'm a person of worth, at least on an equal plane with others.	198	54.4	136	37.4	25	6.9	5	1.4
Item 8 - I wish I could have more respect for myself. *	62	17.0	111	30.5	75	20.6	116	31.9
Item 9 - All in all, I am inclined to feel that I am a failure. *	23	6.3	74	20.3	110	30.2	157	43.1
Item 10 - I take a positive attitude toward myself.	96	26.4	181	49.7	78	21.4	9	2.5
Group 1 (undergone, n=215)								
Item 1 - On the whole, I am satisfied with myself.	57	26.5	108	50.2	40	18.6	10	4.7
Item 2 - At times I think I am no good at all. *	9	4.2	42	19.5	70	32.6	94	43.7
Item 3 - I feel that I have a number of good qualities.	121	56.3	85	39.5	5	2.3	4	1.9
Item 4 - I am able to do things as well as most other people.	113	52.6	86	40.0	14	6.5	2	0.9
Item 5 - I feel I do not have much to be proud of. *	19	8.8	25	11.6	55	25.6	116	54.0
Item 6 - I certainly feel useless at times. *	12	5.6	56	26.0	72	33.5	75	34.9
Item 7 - I feel that I'm a person of worth, at least on an equal plane with others.	128	59.5	73	34.0	10	4.7	4	1.9
Item 8 - I wish I could have more respect for myself. *	34	15.8	58	27.0	49	22.8	74	34.4
Item 9 - All in all, I am inclined to feel that I am a failure. *	8	3.7	36	16.7	66	30.7	105	48.8
Item 10 - I take a positive attitude toward myself.	59	27.4	118	54.9	34	15.8	4	1.9
Group 2 (planning, n=149)								
Item 1 - On the whole, I am satisfied with myself.	32	21.5	61	40.9	48	32.2	8	5.4
Item 2 - At times I think I am no good at all. *	20	13.4	44	29.5	31	20.8	54	36.2
Item 3 - I feel that I have a number of good qualities.	67	45.0	67	45.0	15	10.1	0	0.0
Item 4 - I am able to do things as well as most other people.	71	47.7	64	43.0	14	9.4	0	0.0
Item 5 - I feel I do not have much to be proud of. *	6	4.0	26	17.4	54	36.2	63	42.3
Item 6 - I certainly feel useless at times. *	22	14.8	49	32.9	38	25.5	40	26.8
Item 7 - I feel that I'm a person of worth, at least on an equal plane with others.	70	47.0	63	42.3	15	10.1	1	0.7
Item 8 - I wish I could have more respect for myself. *	28	18.8	53	35.6	26	17.4	42	28.2
Item 9 - All in all, I am inclined to feel that I am a failure. *	15	10.1	38	25.5	44	29.5	52	34.9
Item 10 - I take a positive attitude toward myself.	37	24.8	63	42.3	44	29.5	5	3.4

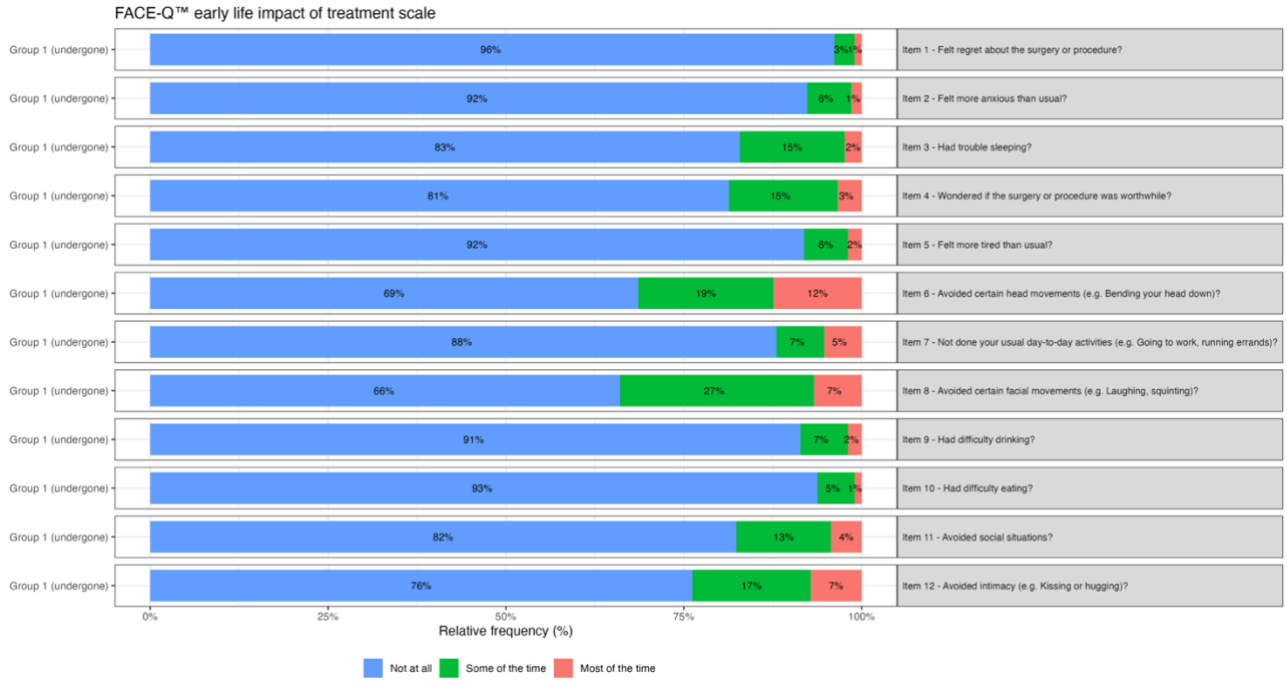
Values may range from 0 to 30 on the Rosenberg Self-Esteem Scale. Negatively worded items are marked with asterisks.

Appendix 2. Responses on the BFNE-S (122)

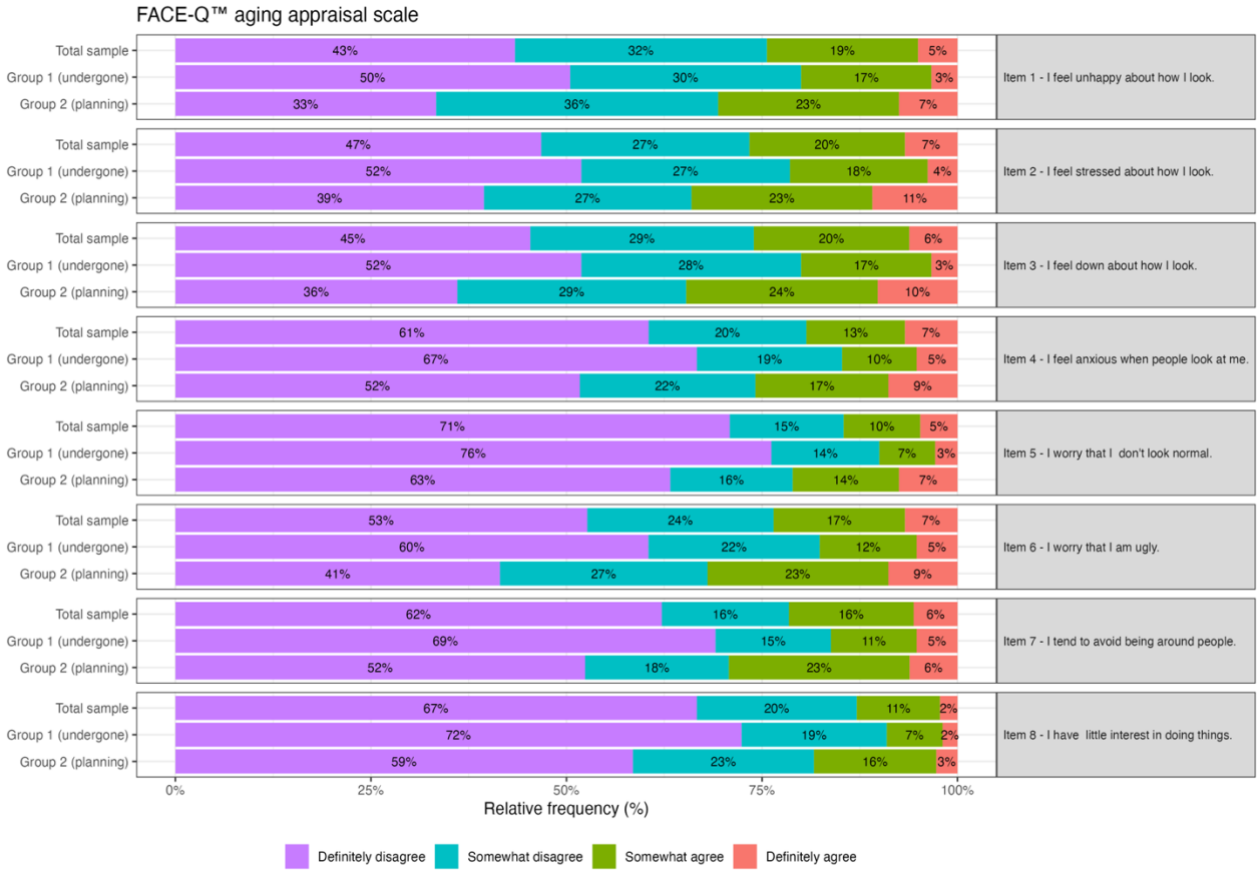
Items	Not at all characteristic of me		Slightly characteristic of me		Moderately characteristic of me		Very characteristic of me		Extremely characteristic of me	
	n	%	n	%	n	%	n	%	n	%
Total sample (n=364)										
Item 1 - I worry about what other people will think of me even when I know it doesn't make any difference.	89	24.5	155	42.6	38	10.4	49	13.5	33	9.1
Item 2 - I am frequently afraid of other people noticing my shortcomings.	92	25.3	150	41.2	37	10.2	48	13.2	37	10.2
Item 3 - I am afraid others will not approve of me.	145	39.8	145	39.8	33	9.1	25	6.9	16	4.4
Item 4 - I am afraid that other people will find fault with me.	124	34.1	145	39.8	32	8.8	34	9.3	29	8.0
Item 5 - When I am talking to someone, I worry about what they may be thinking about me.	134	36.8	135	37.1	37	10.2	36	9.9	22	6.0
Item 6 - I am usually worried about what kind of impression I make.	109	29.9	136	37.4	56	15.4	28	7.7	35	9.6
Item 7 - Sometimes I think I am too concerned with what other people think of me.	132	36.3	106	29.1	47	12.9	35	9.6	44	12.1
Item 8 - I often worry that I will say or do the wrong things.	53	14.6	148	40.7	60	16.5	56	15.4	47	12.9
Group 1 (undergone, n=215)										
Item 1 - I worry about what other people will think of me even when I know it doesn't make any difference.	60	27.9	95	44.2	22	10.2	25	11.6	13	6.0
Item 2 - I am frequently afraid of other people noticing my shortcomings.	62	28.8	95	44.2	17	7.9	26	12.1	15	7.0
Item 3 - I am afraid others will not approve of me.	94	43.7	87	40.5	17	7.9	11	5.1	6	2.8
Item 4 - I am afraid that other people will find fault with me.	80	37.2	86	40.0	21	9.8	17	7.9	11	5.1
Item 5 - When I am talking to someone, I worry about what they may be thinking about me.	91	42.3	82	38.1	19	8.8	15	7.0	8	3.7
Item 6 - I am usually worried about what kind of impression I make.	71	33.0	89	41.4	33	15.3	10	4.7	12	5.6
Item 7 - Sometimes I think I am too concerned with what other people think of me.	88	40.9	61	28.4	26	12.1	19	8.8	21	9.8
Item 8 - I often worry that I will say or do the wrong things.	35	16.3	102	47.4	32	14.9	27	12.6	19	8.8
Group 2 (planning, n=149)										
Item 1 - I worry about what other people will think of me even when I know it doesn't make any difference.	29	19.5	60	40.3	16	10.7	24	16.1	20	13.4
Item 2 - I am frequently afraid of other people noticing my shortcomings.	30	20.1	55	36.9	20	13.4	22	14.8	22	14.8
Item 3 - I am afraid others will not approve of me.	51	34.2	58	38.9	16	10.7	14	9.4	10	6.7
Item 4 - I am afraid that other people will find fault with me.	44	29.5	59	39.6	11	7.4	17	11.4	18	12.1
Item 5 - When I am talking to someone, I worry about what they may be thinking about me.	43	28.9	53	35.6	18	12.1	21	14.1	14	9.4
Item 6 - I am usually worried about what kind of impression I make.	38	25.5	47	31.5	23	15.4	18	12.1	23	15.4
Item 7 - Sometimes I think I am too concerned with what other people think of me.	44	29.5	45	30.2	21	14.1	16	10.7	23	15.4
Item 8 - I often worry that I will say or do the wrong things.	18	12.1	46	30.9	28	18.8	29	19.5	28	18.8

BFNE-S Brief version of the Fear of Negative Evaluation Scale - Straightforward Items. Values may range from 8 to 40 on the Brief Fear of Negative Evaluation Scale - Straightforward Items

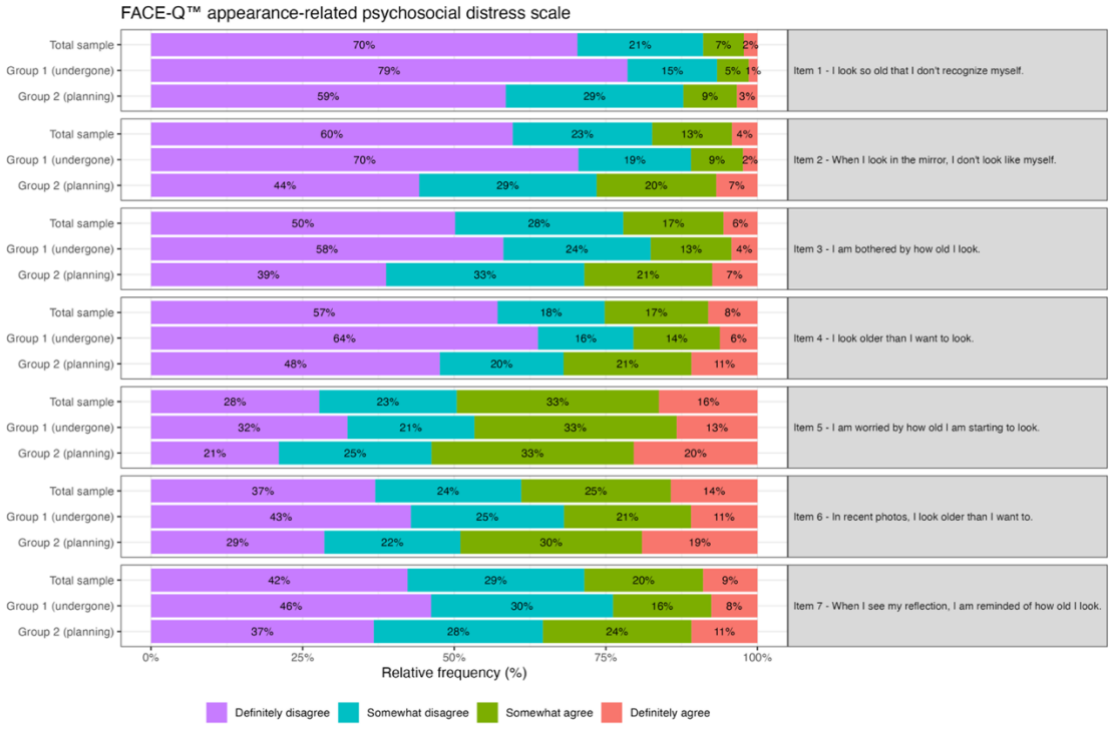
Appendix 3. Distribution of the responses on the FACE-Q Early Life Impact scale (152)



Appendix 4. Distribution of the responses on the FACE-Q Aging Appraisal Scale (152)



Appendix 5. Distribution of the responses on the FACE-Q Appearance Distress scale (152)



Appendix 6. The Hungarian version of the Participant Information and Informed Consent Form used in this study

RÉSZTVEVŐI TÁJÉKOZTATÓ

Tisztelt Hölgyem / Uram!

Ön az alábbi kérdőív kitöltésével a Semmelweis Egyetem Általános Orvostudományi Kar, Bőr-, Nemikórtani és Bőronkológiai Klinika, illetve a Budapesti Corvinus Egyetem, Egészségpolitika Tanszék *„Esztétikai kezelésen átesett páciensek életminőségének vizsgálata”* témájú kutatásában vesz részt. Kutatásunk célja, hogy jobban megismerjük a minimál invazív esztétikai beavatkozáson átesett páciensek tapasztalatait, életminőségét és jóllétét.

Kutatásunkban bárki részt vehet, aki 18. életévét betöltötte és akinél az elmúlt 2 hónapban minimál invazív esztétikai beavatkozás történt. Minimálinvazív esztétikai beavatkozásnak számít a hialuronsavas feltöltés, botulinum toxin kezelés, orvosi hámlasztás, lézerkezelés, bioszálas kezelések, PRP kezelés, mezoterápia. A műtéti eljárások nem tartoznak ide. A résztvevőket egy hozzávetőlegesen 20 perc hosszúságú anonim kérdőív kitöltésére kérjük. A kutatásban való részvétel önkéntes és a részvételért Ön semmiféle ellenszolgáltatásra nem jogosult.

A kutatás feldolgozott eredményeit, melyek anonim módon tartalmazzák az egyes kitöltők adatait, tudományos és ismeretterjesztő közlemények formájában publikáljuk. A személyes adatok felhasználása a vonatkozó adatvédelmi törvény szigorú betartásával történik. A kutatás Tudományos Etikai Engedélyének száma: SE/RKEB: 15/2023.

Kapcsolattartó, kutatócsoport vezetője:

Dr. Kemény Lajos

Tudományos munkatárs, kutatásvezető
Semmelweis Egyetem, Általános Orvostudományi Kar, Bőr-, Nemikórtani és Bőronkológiai Klinika
Tel.: (+36-1) 459 1500

BELEEGYEZŐ NYILATKOZAT

Kutatás címe: Esztétikai beavatkozáson átesett páciensek életminőségének vizsgálata

Köszönjük, hogy részt vesz a kutatásban! A kutatás során nyert adatok felhasználása a vonatkozó adatvédelmi törvény szigorú betartásával történik. Ahhoz, hogy az Ön által kitöltött kérdőívet, a nyert adatok teljes titokban tartásával, tudományosan elemezhessük, az Ön beleegyezése szükséges. Ezért kérjük, olvassa el és töltse ki az alábbi nyilatkozatot.

A résztvevői tájékoztatót elolvastam, tisztában vagyok a kutatás céljaival és menetével.

☐ Igen
☐ Nem

A kérdőív kitöltésével hozzájárulok, hogy adataim anonim módon, az adatbázis részeként, a kutatás keretében felhasználásra kerüljenek.

☐ Igen
☐ Nem

Tisztában vagyok azzal, hogy bármikor megszakíthatom a kutatásban való részvételemet.

☐ Igen
☐ Nem

További kérdést kíván-e föltenni?

☐ Igen
☐ Nem

Ha bármilyen további kérdése vagy a kutatással kapcsolatos észrevétele van, kérjük forduljon kutatócsoportunk vezetőjéhez:

Kapcsolattartó, kutatócsoport vezető:
Dr. Kemény Lajos
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