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Original Research

Non-technical attributes and surgical experience: A cross-sectional study comparing communication styles and attitudes in surgical staff, trainees and applicants

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ABSTRACT

Background: This monocentric study aimed to explore whether key non-technical attributes can be reliably measured in a mixed population of candidates applying for surgical training, surgical trainees and staff and to identify any differences between these groups.

Materials & methods: Candidates applying for surgical training, surgical trainees and staff from four surgical specialties (general surgery, orthopedics, plastic surgery or urology) at a tertiary academic teaching hospital were all sent an online self-report questionnaire. The Communication Styles Inventory (CSI, 96 items) was used to assess a six-dimensional behavioral model of participant communication styles (expressiveness, preciseness, verbal aggressiveness, questioningness, emotionality and impression manipulativeness). Attitudes toward uncertainty and risks were assessed with the Physicians' Reaction toward Uncertainty (PRU, 15 items) and Physician Risk Attitudes (PRA, 6 items) scales respectively. Data was encoded and analyzed using parametric testing.

Results: The questionnaire was completed by 177 participants (110 candidates; 42 trainees; 25 staff). All scales had very good internal consistency (Cronbach's alpha > 0.80). After controlling for gender-based differences, surgical candidates scored significantly higher on 'expressiveness' ($P = 0.012$) and were significantly less risk-averse ($P = 0.006$) than trainees and staff. Surgical trainees scored lowest on the CSI 'questioningness' subscale ($P = 0.019$) and had significantly more difficulties dealing with uncertainty, characterized by their highest scores on the 'concern about bad outcome' ($P = 0.021$) and reluctance to disclose uncertainty to patients' ($P = 0.05$) subscales.

Multiple subscales revealed gender-based differences in candidate and trainee groups, which were not noted for surgical staff.

Conclusions: Meaningful differences in non-technical attributes of surgical staff, trainees and candidates have been identified, which may be explained by differences in clinical experience and learning and may suggest that these develop over time. Further research on assessment of non-technical attributes during surgical selections and the role of both technical and non-technical attributes in surgery at large is needed.

1. Introduction

Errors and adverse events in the operative setting are more frequently caused by deficiencies in non-technical aspects of patient care than technical issues [1,2]. Some argue that surgical education needs to put more emphasis on non-technical attributes, which can be defined as critical cognitive and interpersonal skills (e.g. communication) and professional attitudes (e.g. risk aversion) that complement surgeons' technical abilities and contribute to safe and efficient task performance' [1].

While deficiencies in these attributes may lead to errors and poor clinical outcomes [1–4], well-developed non-technical attributes may enhance technical skills and help to create positive working and learning environments, thereby reducing burnout-risk and dropout of healthcare personnel and trainees [5]. Although empirical evidence has demonstrated the vital role of non-technical attributes in high-risk fields, such as surgery, it remains unclear to what extent surgical candidates possess these attributes and if these change over time.

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Traditional tools to assess non-technical skills in surgery are often labor-intensive, require specific training of assessors and can only be performed during simulated or real-life procedures [6]. Due to surgical candidates' limited experience [7,8] and financial constraints, self-assessment of non-technical attributes is proposed as a more feasible, less demanding and valid alternative. Indeed, research in various professional groups has shown that non-technical attributes such as communication styles and professional attitudes can validly be measured through self-assessment [9–13].

Communication styles can be defined as 'the characteristic way people send verbal, paraverbal, and nonverbal signals in social interactions, denoting who they are or want to (appear to) be, how they tend to relate to people with whom they interact, and in what way their messages should usually be interpreted' [9]. As communicating is a core activity in surgery and communication styles may influence one's leadership behavior and professional outcomes (e.g. relations with colleagues and patients) [10], it's surprising that these communication styles have not been studied in surgery.

Furthermore, attitudes towards uncertainty and risk can also be measured via self-assessment. These non-technical attributes have already been investigated in surgical trainee and staff populations [11,14,15], but not yet in surgical candidates.

Therefore, the current study aims to explore whether communication styles and attitudes towards risk and uncertainty can be reliably measured in this mixed population of surgical staff, trainees and inexperienced candidates and if any differences exist between these groups.

2. Material and methods

2.1. Sample and procedure

Three groups with varying clinical experience were recruited from four surgical specialties: general surgery, orthopedics, plastic surgery and urology. Between 2016 and 2018, three cohorts of surgical candidates applying for training in one of these specialties were invited to participate. Candidates could apply at the end of their Master in Medicine program or afterwards. One cohort of candidates received mentoring sessions during their medical undergraduate education while the others did not.

A second participant group consisted of surgical trainees who were already in training at an academic hospital or an associated non-academic training hospital. Trainees from all postgraduate years of experience were included.

The last participant group consisted of surgical staff members employed at the same academic hospital.

Data was collected using online questionnaires and encoded. No exclusion criteria were applied, participants were invited through e-mail and reminders were sent to non-responders at two-week intervals. Participation was voluntary, after signing online informed consent. This single-center observational study was approved by the local ethics committee (registration number B670201628799). This work has been reported in line with the STROCSS criteria [16].

2.2. Measures

The rating scales in this study were selected by the second author, who is active in the field of occupational psychology and familiar with the existing literature.

2.2.1. Communication styles

These were measured through the Dutch full version of the communication styles inventory (CSI) [9], developed by De Vries et al. [9,10]. The CSI-scale is a self-report questionnaire containing 96 statements, assessing 6 dimensions of communicative behavior (Table 1). Each dimension is measured through 16 statements (e.g. 'I weigh my answers carefully'), which are rated using 5-point Likert scales. Per dimension, a mean item-score is calculated, which indicates how closely the communication style matches that specific dimension. Scale validity has been shown in heterogeneous Dutch populations consisting of university students [9] and healthcare- and non-healthcare employees [10].

2.2.2. Attitudes towards uncertainty

The Revised "physicians' reaction to uncertainty" scale (PRU) [12] assesses how participants cope with uncertainty in healthcare. It contains 15 items which are scored on a 6-point Likert scale (e.g. 'Uncertainty in patient care makes me uneasy') and cover four subscales. For each subscale, a total sum-score is calculated. A high sum-score indicates difficulty in coping with uncertainty. Translation/back-translation procedures were used to obtain the Dutch version, semantically equivalent to the original scales.

2.2.3. Attitudes towards risk

These were assessed with the "Physician risk attitude" scale (PRA) [13], consisting of six items (e.g. 'I enjoy taking risks'), scored on a 6-point Likert scale. A high sum-score indicates greater aversion towards risks. Translation/back translation procedures were utilized.

2.2.4. Health status and life satisfaction

To assess potential health status related differences between groups, the RAND Short Form 36 health survey (RAND SF-36), a standardized self-reporting questionnaire, was used [17,18]. It contains 36 items, covering eight health dimensions and the participant's perceived change in general health during last year. Participants' current life satisfaction was compared using a self-constructed 5-point Likert scale, with smiley faces (Fig. 1), ranging from sad (score of one) to happy (score of five).

2.3. Statistical analysis

Data analysis was conducted using SPSS 24.0 (Statistical Package for the Social Sciences, IBM Corp, Armonk, NY, USA). Data processing was performed after completion of the surgical selection process. General differences for the CSI− and PRU-scales across genders and participant groups were investigated using MANOVA testing. Differences on CSI− and PRU-subscale level and for the PRA-scale were examined using two-way ANOVA testing, corrected for gender-based differences, in line with previous research [9]. Tukey Post-hoc tests were utilized to explore differences between individual participant groups. P-values < 0.05 were considered to be statistically significant.

3. Theory

Our assumption is that communication styles and attitudes towards uncertainty and risks can be reliably assessed through on-line questionnaires and that significant differences in non-technical attributes do exist between inexperienced surgical candidates and more experienced surgical trainees and staff members.

4. Results

4.1. Participants

Out of 304 surgical candidates, trainees and staff members, 177 (58.2%) completed the survey (Table 2). Mean age was respectively 25, 28 and 47 years. One-hundred and four males and seventy-three females participated, with the highest participation rate in the candidates group (110/149, 73.8%). Ninety-six candidates were last-year medical students and fourteen were postgraduates.

Surgical candidates from the three selection cohorts were comparable for communication styles and attitudes towards uncertainty and

Table 1
Meaning of CSI[a] dimensions.

CSI dimension	Meaning of a high score on dimension scale:
1. Expressiveness	A talkative, dominant, informal communication style with use of humor.
2. Preciseness	A reflective, thoughtful, structured way of communicating, often straight to the point.
3. Verbal aggressiveness	An authoritarian, non-supportive or even derogatory communication style and tend to react with anger when displeased or frustrated.
4. Questioningness	An argumentative, inquisitive communication style with unconventional ideas and philosophical thoughts.
5. Emotionality	People who often are sentimental, have problems to function when stressed or worried and have problems dealing with others' opinion and critique.
6. Impression manipulativeness	People who influence others by using their charm or by following others' ideas and opinions, while hiding their own feelings or ideas. These people also tend to withhold or conceal information from others if this benefits them.

[a] CSI: Communication styles Inventory [9].

risk, independent of receiving mentoring sessions or not during their medical education (Appendix A).

4.2. Communication styles

Reliability analysis in this study revealed very good internal consistency for all subscales (Cronbach Alpha values: 0.822–0.857). Exploratory factor analysis indicated that an oblique 6-factor solution explained 62.45% of the variance in the CSI data, with all factors having an eigenvalue greater than one.

Female candidates and trainees scored significantly higher on 'emotionality', while males scored significantly higher on 'impression manipulativeness'. These differences were absent for staff (Table 3). Furthermore, 'questioningness' scores for male candidates were significantly higher than for female candidates; other groups did not show this difference (Table 3).

After correcting for gender-based differences, candidates scored significantly higher than other groups on 'expressiveness', while they had significantly lower scores on 'verbal aggressiveness' (Table 4). For 'questioningness', trainees scored significantly lower than both candidates and staff members. For the remaining dimensions no significant differences were identified, after controlling for gender-based differences (Table 4).

4.3. Attitudes towards uncertainty

Internal consistency was very good (Cronbach alpha values: 0.805–0.942). Two-way MANOVA analysis showed meaningful differences between genders [$F(4,168) = 2.711$; $P < 0.032$] and participant groups [$F(8,338) = 2.471$; $P = 0.013$].

Gender-based differences were observed for 'Anxiety due to uncertainty' subscale: female candidates and trainees scored significantly higher than males (Table 3). Additionally, female candidates also had significantly higher scores for 'concern about bad outcomes' than their male counterparts.

In the staff group, gender-based differences were not observed.

Two PRU-subscales were statistically significantly different across groups (Table 4): staff scores on the 'Concern about bad outcomes' and 'reluctance to disclose mistakes to other physicians' subscales were significantly lower than candidate and trainee scores. Trainees had the highest score for 'Reluctance to disclose uncertainty to patients', although the difference was (borderline) non-significant.

4.4. Attitudes towards risk

Internal consistency was very good (Cronbach alpha: 0.850). Gender-related differences were absent. Candidates scored significantly lower on the PRA-scale compared to both other groups (Table 4).

4.5. Current health status and life satisfaction

Overall, all participants were both mentally and physically healthy, and satisfied with their current life, with candidates most often scoring highest and staff scoring lowest (Appendix B). Specifically, candidates scored highest on the 'physical functioning (29.54; 29.10; 28.64; $P = 0.029$) and the 'pain' subscales (57.08; 54.12; 52.52; $P = 0.002$), reflecting candidates perceive their physical functioning at large as better and experienced the lowest physical pain complaints during the last four weeks, compared to the other participant groups.

5. Discussion

This is the first study attempting to assess non-technical attributes in a three-sample public, of surgical candidates, trainees and staff members, using self-assessment tools. Although the three groups differed greatly in age and surgical related work experience, no meaningful differences in general health or life satisfaction were seen.

5.1. Candidates

Surgical candidates were mainly undergraduate students and had the least clinical experience. They were recruited during three periods of selection, between 2016 and 2018. Due to a reformation in the educational system, candidates from the first two periods had followed a seven-year curriculum, without mentoring, while candidates from the third selection period (June 2018) followed a six-year curriculum with group-based and individual mentoring sessions by experienced staff members. However, this difference in educational system did not seem to affect participants' communication styles and professional attitudes (Appendix A).

Candidates' lowest score on the PRA-scale, suggests they are significantly less risk-averse than more experienced groups. Possibly, their lack of clinical experience causes misinterpretation of risks and consequences of clinical choices (e.g. whether to operate), as they often only see, hear and observe (successful) results after others already made the decisions, possibly making them more favorable towards taking risks.

Fig. 1. Current life satisfaction scale.

Table 2
Overview response rates and sample demographics.

		Candidates[a] (n = 110)	Trainees (n = 42)	Staff (n = 25)
Discipline	General surgery	-	22/41 (53.6%)	13/20 (65%)
N (Response rate)	Orthopedics	-	8/40 (20%)	7/12 (50%)
	Plastic surgery	-	4/5 (80%)	2/6 (33.3%)
	Urology	-	8/23 (34.7%)	3/8 (37.5%)
	Total	110/149 (73.8%)	42/109 (38.5%)	25/46 (54.3%)
Gender (M/F)		64/46	23/19	17/8
Mean age[b]		24.73 (2.33)	28.36 (2.08)	47.12 (8.56)

[a] Unfilled cells due to ongoing surgical selection procedure of applicants.
[b] Standard deviation is mentioned between brackets.

Secondly, as leaders' leadership-outcomes have been shown to strongly relate to their expressiveness, as perceived by subordinates [10], surgical staff could be expected to score highest on the expressiveness subscale. Yet surprisingly, candidates in this study had significantly higher expressiveness scores than trainees and staff. This may suggest that as clinical responsibilities increase, expressiveness decreases, causing candidates' open, talkative communication style to change into a more formal, professional one, potentially at the cost of their leadership qualities.

However, while this is an intriguing premise, predictive validity of self-assessed expressiveness for future clinical leadership is not yet demonstrated. Therefore further research should explore whether self-assessment of communication styles is in line with the assessments made by others (e.g. peers, experts, referees), since these inexperienced candidates' highest expressiveness scores may also reflect an overestimation bias, caused by their youthful enthusiasm [19].

Finally, candidates were the least verbally aggressive of all groups. This may indicate that throughout surgical training and further professional life, a more verbally aggressive communication style is developed, which has also been suggested in recent literature [20]. However, it should be noted that when completing the questionnaire, most candidates were doing internships, during which they were constantly evaluated and less likely to be exposed to stressful and/or frustrating work situations (e.g. surgical errors), which may elicit verbally aggressive responses.

5.2. Trainees

Surgical trainees scored significantly lower than other groups on the CSI dimension 'questioningness'. This is surprising, as one expects trainees to be inquisitive and open to new ideas and information. Perhaps trainees are overwhelmed by high workloads and the amount of new information, hindering them to remain questioning or raise new ideas themselves. Staff on the other hand, possibly rely more on personal experience instead of others' opinions, allowing them to 'think out of the box' more frequently. Additionally, staff members in this study worked in an academic institution, where criticism and inquisitiveness are natural, which is reflected in their highest 'questioningness' scores.

Secondly, trainees scored highest on three PRU-subscales, of which two subscales differed significantly from staff member scores, even though both groups likely are exposed to similar causes of uncertainty. We speculate that surgical trainees' higher scores reflect their experiences during training, where they are confronted with various sources of uncertainty, demands and paradoxes, which may be experienced as threatening and result in negative feelings (e.g. anxiety).This illustrates the importance of acquiring appropriate coping strategies and adequate technical- and non-technical skills to allow trainees to deal with daily stressful situations, uncertainty and mistakes more efficiently. This may for example be facilitated through structured training programs, focusing on these topics, preferably before or early in the beginning of surgical training [21]. Additionally, the precise role of clinical experience in coping abilities should be studied further, together with the conditions (e.g. work climate) and pathways (e.g. experiential learning, reflection, peer teaching) facilitating or hindering its potential influence.

5.3. Staff

Staff members scored, only in absolute terms, the lowest on 'impression manipulativeness' and the highest on 'emotionality' communication style domains.

Although these CSI-dimensions were not significantly different between groups, gender-related differences were noted within groups. Such differences have been previously described [9], indicating that females score significantly higher on 'emotionality' while males have higher 'Impression manipulativeness' scores. We confirmed these

Table 3
Gender differences in communication styles and attitudes across participant groups.

		Candidates (n = 41)			Trainees (n = 42)			Staff (n = 25)		
		Mean (SD)		P-Value	Mean (SD)		P-Value	Mean (SD)		P-Value
		Male (n = 26)	Female (n = 15)		Male (n = 23)	Female (n = 19)		Male (n = 17)	Female (n = 8)	
CSI Subscales	Impression Manipulativeness (/5)[a]	2.94 (0.46)	2.52 (0.64)	**0.017**	2.96 (0.50)	2.38 (0.42)	< **0.001**	2.61 (0.50)	2.48 (0.35)	0.501
	Questioningness (/5)	3.42 (0.54)	3.10 (0.57)	**0.004**	3.05 (0.49)	2.98 (0.53)	0.684	3.49 (0.59)	3.26 (0.35)	0.316
	Emotionality (/5)	2.37 (0.49)	2.95 (0.49)	**0.001**	2.56 (0.50)	3.07 (0.4875)	**0.002**	2.82 (0.34)	2.85 (0.69)	0.877
PRU subscales	Anxiety due to uncertainty (/30)	14.39 *(5.07)*	16.41 *(4.94)*	**0.039**	14.00 *(4.5)*	17.74 *(3.62)*	**0.005**	16.0 *(4.95)*	11.88 *(5.00)*	0.074
	Concern about bad outcomes (/18)	7.94 *(3.37)*	9.50 *(3.46)*	**0.028**	8.43 *(4.04)*	10.26 *(3.14)*	0.115	7.0 *(4.12)*	6.38 *(2.56)*	0.699

P-values < 0.05 are mentioned in bold.
CSI: Communication styles Inventory; PRU: Physicians' reaction to uncertainty.
[a] Maximum scale score is mentioned between brackets.

Table 4
Comparative results: Communication styles, attitudes towards uncertainty and risk in the three participant groups.

		Mean (SD)			P-value[b]				Cronbach alpha
		Candidates (n = 41)	Trainees (n = 42)	Staff (n = 25)	Overall	Candidates vs. Trainees	Trainees vs. Staff	Candidates vs. Staff	
CSI sub-scales	Expressiveness (/5)[a]	3,39 (0,51)	3,19 (0,52)	3,13 (0,46)	**0.012**	.067	0.898	0.053	0.857
	Preciseness (/5)	3,31 (0,47)	3,32 (0,45)	3,59 (0,57)	0.148	0.999	0.068	**0.028**	0.847
	Verbal aggressiveness (/5)	2,33 (0,48)	2,6 (0,42)	2,58 (0,58)	**0.001**	**0.006**	0.989	**0.045**	.0.824
	Questioningness (/5)	3,29 (0,57)	3,02 (0,5)	3,42 (0,53)	**0.019**	**0.020**	**0.013**	0.543	0.836
	Emotionality (/5)	2,72 (0,61)	2,78 (0,55)	2,83 (0,46)	0.796	0.779	0.937	0.614	0.856
	Impression Manipulativeness (/5)	2,7 (0,56)	2,7 (0,54)	2,57 (0,45)	0.542	0.998	0.562	0.447	0.822
PRU sub-scales	Anxiety due to uncertainty (/30)	15,24 (5,1)	15,69 (4,49)	14,68 (5,24)	0.310	0.862	0.685	0.861	0.855
	Concern about bad outcomes (/18)	8,59 (3,69)	9,26 (3,74)	6,8 (3,65)	**0.021**	0.569	**0.022**	0.071	0.805
	Reluctance to disclose uncertainty to patients (/30)	11,97 (4,58)	14,12 (4,96)	11,12 (5,13)	0.05	**0.034**	**0.034**	0.693	0.841
	Reluctance to disclose mistakes to physicians (/12)	4,75 (2,19)	4,57 (1,7)	3,56 (2,38)	**0.022**	0.891	0.138	**0.031**	0.942
PRA scale	Physicians' risk attitude (/36)	20,57 (6,1)	23,88 (6,34)	23,84 (6890)	**0.006**	**0.012**	1.000	0.053	0.850

CSI: Communication styles Inventory; PRU: Physicians' reaction to uncertainty; PRA: Physician risk attitude.
[a] Maximum scale score is mentioned between brackets.
[b] P-values adjusted for gender-based differences; P-values < 00.05 are highlighted in bold.

differences in both the candidate and trainee participant groups, but they were absent in the staff group. A similar situation was found for the PRU-subscale 'Anxiety due to uncertainty' for which female candidates and trainees scored higher than their male counterparts, while staff members showed no gender-related differences. This possibly indicates that staff members acquire more uniform communication styles, through shared (in)formal learning experiences and/or practise.

Finally, staff members and surgery trainees reported similar extents of risk taking behavior, reflecting that both groups are aware of professional risks. From an educational point of view, this is a pursued training outcome.

5.4. Surgical 'gold standard'

The results described above seem to suggest that some non-technical attributes (e.g. risk attitude) change progressively throughout professional training and that trainees may grow towards a common profile set by staff members. Preece et al. [22] made similar observations and noted that as training progresses, surgical trainees adapt their behavior and become more emotionally stable.

This raises the question to what extent surgical staff members share a common behavioral work style or ethic.

Previous studies already attempted to characterize well-performing surgeons and trainees through a so called surgical 'gold standard' based on assessments of various personality- and behavioral factors [23–26]. Although the relationship between communication styles and good clinical performance has not been studied yet, communication styles have already been shown to be closely related to and even have incremental validity above personality factors [9,10]. This implies that a surgical 'gold standard' may be enriched with other non-technical attributes, to obtain a more complete surgical profile, which could prove useful as a benchmark in surgical candidate selection.

Moreover, assessment of non-technical attributes may be useful during surgical training since it may identify trainees struggling with their professional responsibilities, uncertainties and risks and who may benefit from additional professional and educational guidance.

5.5. Limitations and further research

These results need to be interpreted with some caution, since only self-report measures were used. These are susceptible to common method variance and self-report bias, which are influenced by factors such as propensity to give socially desirable responses, fear for punishment and situational pressures and cannot be completely eliminated [27]. This may have affected surgical candidates, as questionnaires were collected one month before the surgical selection procedures, potentially causing candidates to give answers that they deemed socially desirable [28]. Nevertheless, to limit these effects, authors used existing valid scales and made participation voluntary. Moreover, candidates were clearly informed that answers would not be identifiable and did not influence selection procedures in any way.

Secondly, response rate in the surgical trainee group was lower, mainly due to few responses from trainees in peripheral non-academic training hospitals (20/69 'peripheral' trainees responded). This is likely due to the increased difficulty of reaching and motivating these peripheral trainees, especially when compared to those employed by the academic hospital. Additionally, participants were not matched, therefore we cannot fully exclude a sampling bias but, this is likely limited, since the demographics of each group reflected the population characteristics well. Additionally, there were no relevant differences regarding participants' general life satisfaction and current health status, despite their age and work experience differences. Finally, the statistical analyses were controlled for gender, implying that the described similarities and differences between the three participant groups are independent of participants' gender.

Although the present study showed meaningful differences between groups, prospective studies are needed to accurately assess how non-technical attributes evolve throughout surgical training and to investigate any predictive value of these non-technical attributes for surgical proficiency, potential use during surgical selections and use for identification of trainees at risk of dropout. Further, it may be interesting to investigate whether 'high ranking' surgical candidates possess different non-technical attributes compared to 'low ranking' peers. Future research may also identify additional non-technical attributes relevant for surgery and the potential joined effect of non-technical attributes and technical skills on educational and work outcomes, aiming to foster human-centered surgery.

6. Conclusion

Communication styles and attitudes towards uncertainty and risk can be reliably measured through self-assessment in a surgical population of experienced staff, trainees and novices (candidates). Moreover, we demonstrated differences in these non-technical attributes, which

are possibly attributable to differences in their clinical experience and educational learning, suggesting that some non-technical attributes develop over time. This study may form the base for further validation research and initiate advanced practices (e.g. medical curriculum development), thereby potentially contributing to better clinical performance and promotion of psycho-social well-being in (future) surgeons.

Ethical approval

This single-center observational study was approved by the local ethics committee (registration number B670201628799).

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Author contribution

All authors have made substantial contributions to the manuscript justifying authorship. The manuscript was read and approved by all authors.

Conflicts of interest

The authors do not have any conflicts of interest to disclose relevant to the completion of this manuscript.

Research registry number

This study was registered at clinicaltrials.gov with the registration number: NCT03728088.

Guarantor

The first author and all co-authors accept full responsibility for the work and/or the conduct of the study and controlled the decision to publish.

The first author had access to the study data and databases.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Data statement

The questionnaires used in this study contain potentially sensitive information, therfore the study participants were assured in the informed consent document that their answer data would not be shared.

CRediT authorship contribution statement

Bart Doyen: Conceptualization, Methodology, Writing - review & editing, Data curation, Formal analysis, Investigation, Project administration, Writing - original draft, Visualization. **Peter Vlerick:** Conceptualization, Methodology, Writing - review & editing, Supervision, Visualization. **Heidi Maertens:** Conceptualization, Methodology, Writing - review & editing, Visualization. **Frank Vermassen:** Conceptualization, Methodology, Writing - review & editing, Supervision, Visualization. **Isabelle Van Herzeele:** Conceptualization, Methodology, Writing - review & editing, Supervision, Visualization.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijsu.2019.02.002.

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