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Are healthcare professionals' implicit and explicit attitudes towards conventional DMARDs associated with those of their patients?

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Abstract

Objectives

Up to now, it is unknown if healthcare professional (HCP)'s attitudes and beliefs might affect attitudes, beliefs and medication-taking behaviour of patients with rheumatoid arthritis (RA). This study aims to 1) examine HCPs' attitudes, health-related associations (both implicit and explicit) and beliefs about conventional DMARDs, and 2) to assess

whether these are associated with those of their patients, with patient's medication-taking behaviour and disease activity.

Methods

HCPs were recruited in two rheumatology specialized centers across the Netherlands followed by patient recruitment. In this observational study, implicit outcomes were measured with Single Category Implicit Association Tests, whereas explicit outcomes were measured with a bipolar evaluative adjective scale and the Beliefs about Medicines Questionnaire Specific. Spearman's rank correlations were used to describe correlations between implicit and explicit measures of HCPs. Multilevel mixed effects linear models were used to examine the association of HCP-related characteristics, including HCP's implicit and explicit outcomes, with those of their patients, and medication-taking behaviour and disease activity.

Results

Of the 1659 initially-invited patients, 254 patients with RA (mean age: 62.8yrs, mean disease duration: 11.8yrs, 68.1% female) treated by 26 different HCPs agreed to participate in this study. HCP's characteristics, attitudes, health-related associations and beliefs about medicines were not significantly associated with those of their patients, nor with medication-taking behaviour or disease activity scores.

Conclusion

This study revealed that HCP's attitudes and health-related associations (both implicit and explicit) together with beliefs, were not significantly associated with attitudes, beliefs, medication-taking behaviour, and disease activity of patients with RA.

Significance and Innovations

- Up to now, it is unknown if healthcare professional (HCP)'s attitudes and beliefs might affect attitudes, beliefs and medication-taking behaviour of patients with rheumatoid arthritis (RA).
- This study revealed that HCP's socio-demographic characteristics, implicit and explicit attitudes and health-related associations, and beliefs about medicines were not associated with those of their patients with RA, nor with patient's medication-taking behaviour and disease activity scores.
- These findings provide some first insights into the potential (and the lack thereof) of HCP's implicit and explicit medication perceptions in relation to patient's medication adherence and disease activity

Patients with rheumatoid arthritis (RA) are recommended to use disease-modifying antirheumatic drugs (DMARDs) to suppress the inflammatory response, and consequently, to decrease disease activity and reduce radiological damage (1,2). Despite this beneficial effect of DMARDs, previous studies have reported major issues regarding medication-taking behaviour in RA patients with adherence rates varying from 30% to 107% depending on the used measurement method (3–5). Non-adherence to medication can lead to worsening of clinical outcomes (i.e. high disease activity, radiologic progression, and a decrease in physical functioning and quality of life) and increased healthcare expenditures (6–8). Several attempts are made to explore effective intervention strategies and targets for improving medication-taking behaviour in this population (9). However, so far adherence-improving interventions were only partly effective in changing medication-taking behaviour.

An explanation for the ineffectiveness of adherence-improving interventions might be that previous studies have largely focused on the patient's perspective rather than the perspective of healthcare professionals (HCPs) (9–12). Several studies have suggested that HCP's attitudes and beliefs might be associated with attitudes and beliefs of their patients (13–16). It can, therefore, be assumed that during clinic visits, attitudes and beliefs of HCPs might affect patients' medication-taking behaviour as well. However, targeting patient's concerns and necessity beliefs about medication (17), and making HCPs aware of patients' suboptimal medication-intake (18) does not improve patients' medication-taking behaviour. New insights in processes which may underlie patient's non-adherent medication-taking behaviour or which may influence the patient-provider interaction are, therefore, required

Theoretical and empirical contributions in the field of psychology, provide abundant evidence that much behaviour only in (small) part originates from conscious or reflective thought processes, but largely depends on subconscious or automatic processes (19–22). These dual process theories assume that subconscious or automatic processes explain a unique part of behaviour which cannot be explained by conscious thought (19–22). Extending these findings to adherence research, these dual process theories provide a plausible explanation why the often measured explicitly reported attitudes and beliefs about medicines may give insufficient insight in the processes underlying adherence. Also, they pinpoint automatic processes and specifically implicit attitudes as potentially essential elements in understanding (HCP's communication and patient's medication-intake) behaviour (19–22). In this study, we define implicit attitudes as automatically activated associations, that are based on past experiences and mediate favourable or unfavourable feelings that individuals might not be aware of, whereas explicit attitudes are defined as deliberate or conscious evaluations of medication (20–22). Few studies have investigated patient's implicit attitudes and their association with medication-taking behaviour in rheumatic diseases (23,24), however, studies on HCP's implicit attitudes towards medication in the field of rheumatology are lacking. HCP's implicit attitudes might be involved in the patient-provider interaction (e.g. communication between HCPs and patients), which then might affect patient's attitudes as well as patient's medication-taking behaviour. Up to now, it is unknown whether HCPs' implicit attitudes and beliefs about medication might be associated with patients' implicit attitudes and beliefs about medication, patient's medication-taking behaviour, and patient's disease activity in the field of rheumatic diseases (16,23).

Therefore, the aim of this study is twofold: (1) to examine healthcare professionals' implicit and explicit attitudes and health-related associations with conventional DMARDs together with their explicitly reported beliefs about medicines and (2) to assess whether these are associated with those of their patients, with patient's medication-taking behaviour and patient's disease activity scores.

Patients and Methods

Study design and setting

An observational study was performed in two of the largest rheumatology specialised centres across the Netherlands (i.e. covering approximately 20% of all patients with RA): Sint Maartenskliniek (Nijmegen) and Reade (Amsterdam). Rheumatologists and physician assistants (PAs) were recruited between 2016 July 5th and 2017 January 23th, whereas patients were recruited between 2016 July 5th and 2017 November 30th. This project resulted in a large data set including measures of implicit and explicit attitudes and beliefs toward medication of both patients and HCPs. Van Heuckelum et al focus on the patient data only, see their article for a detailed description on the measurement of patients' implicit and explicit attitudes, medication-taking behaviour and clinical variables (24). This article focuses on the implicit and explicit attitudes of HCPs and explores their associations with patient data. An overview of the study is presented in Table 1. The STROBE statement for observational studies and EMERGE (ESPACOMP Medication Adherence Reporting Guideline) were used as guidance for adequate reporting on this study (25,26).

[Tabel 1]

Eligibility criteria and selection procedures

All rheumatologists, residents, and PAs working at the rheumatology departments of the Sint Maartenskliniek and Reade with a minimum employment contract period of 9 months were asked to participate in this study. Written information about the study protocol (an adapted version for patients) and an informed consent form were attached to an email sent to all rheumatologists and PAs. After agreement by email, a research appointment was made to sign the informed consent form. Subsequently, patients were assessed for eligibility. All consecutive adult (≥ 18 years) patients with a clinical diagnosis of RA, treated with at least one cDMARD for a minimum period of one year, were invited to participate in this study. No additional inclusion and exclusion criteria were defined for patient selection. Written information about the study protocol and an informed consent form were sent by mail to all consecutive patients four weeks before their planned regular consultation with their treating clinician. After patient's agreement to participate in this study, the researcher planned a research appointment before their planned regular consultation in order to sign the informed consent form.

Procedures of data collection

At baseline, HCP's implicit and explicit attitudes and health-related associations together with sociodemographic data (i.e. age, sex, current position, years of working experience and mean hours of patient contact per week) and explicit beliefs about medicines were assessed. Implicit data were collected prior to filling in the hardcopy questionnaires in order to prevent contamination effects of explicit measures with implicit measures. The same procedures were applied to patients at baseline, supplemented with a hardcopy questionnaire to assess self-reported medication-taking behaviour. Electronic monitoring of medication-taking behaviour was continued for a minimum period of three months after patient's inclusion. At patient's follow-up visit, medication event monitoring system (MEMS) read-outs were used to assess medication-taking behaviour over the previous months. Patient's disease activity score (i.e. DAS28-CRP) was assessed in conformity with treatment protocols as part of standard care.

Measurement instruments

Single Category Implicit Association Tests (SC-IATs)

SC-IATs were used to measure two concepts of automatic associations in this study: implicit attitudes (i.e. positive versus negative) and implicit health-related associations (i.e. health versus sickness) with medication. The SC-IAT is considered a reliable and valid instrument to measure implicit associations with a single attitude object (i.e. antirheumatic drugs) (27). Each concept was assessed in three rounds: one practice round of 20 trials followed by two experimental rounds of each 40 trials. Trials displayed various positive/health-related, negative/sickness-related, and medicine-related words and pictures in a computerised categorisation task in which automatic associations were measured based on HCP's and patient's response times. The response times in the experimental rounds serve as a proxy for association strength, where faster responses represent stronger associations. In other words, if HCPs were on average faster in categorising trials coupling drug stimuli and negative (versus positive) stimuli, this reflects a relatively negative (versus positive) automatic association with cDMARDs. SC-IATs for rheumatologists/PAs included five generic pictures of cDMARDs (i.e. methotrexate, leflunomide, hydroxychloroquine, sulfasalazine, and azathioprine), whereas SC-IATs for patients were personalised based on their personal cDMARD use. Supplementary Material S1 File provides a more detailed description of the SC-IATs procedures used in this study.

Bipolar evaluative adjective scale

For both HCPs and patients, a bipolar evaluative adjective scale was used to assess explicit medication attitudes (10 semantic differential scaled items, e.g. I think [name cDMARD(s)] is 1 negative- 5 positive) and explicit health-related associations (8 semantic differential scaled items, e.g. 'to what extent do you associate [cDMARD] with the following terms', 1 dead - 5 alive). Items in this questionnaire represented the same associations with cDMARDs as measured with the SC-IATs (see Supplementary Material S2 File).

Beliefs about Medicines Questionnaire Specific (BMQ-Specific)

HCPs filled in the BMQ-Specific (10 Likert-scaled items) adapted to the perspective of HCPs (e.g. 'Without the medicines my patients would be very ill'), whereas patients filled in the original validated Beliefs about Medicines Questionnaire Specific (e.g. 'Without the medicines I would be very ill'). Item scores varied from 1 (strongly disagree) to 5 (strongly agree), which resulted in sum scale scores of 5 to 25 for each subscale (necessity beliefs versus concern beliefs) (13,28).

Compliance Questionnaire on Rheumatology (CQR) and Medication Event Monitoring System (MEMS)

Self-reported medication-taking behaviour of patients was measured with the validated Compliance Questionnaire on Rheumatology (19 Likert-scaled items, ranging from 1 to 4). Medication Event Monitoring Systems (MEMS, Aardex[®]) were used as electronic monitors to measure medication-taking behaviour based on device usage. A diary to register for unintended openings of MEMS, was handed to patients. Medication-taking behaviour was operationalised as correct dosing, which is defined as the percentage of days on which the correct number of doses was taken.

Clinical (laboratory) outcomes

Clinical characteristics (i.e. serology, disease duration, type and current number of DMARD(s), and disease activity scores (DAS28-CRP)) were extracted from patient's medical file by the local researchers.

Study size

Assuming a sample size requirement of 10 patients per variable, a study sample of 240 patients is sufficient to build a reliable linear model including a maximum of 8 independent variables. Taking into account 15% loss to follow-up, a sample size of 275 patients was required.

Statistical analyses

Statistical analyses were performed with STATA version 13.1. Descriptive statistics were used for describing patient's and HCP's characteristics. Data were presented as percentages in case of proportions. P-values ≤ 0.05 were considered statistically significant. Data obtained from the SC-IATs were expressed as response times in milliseconds (ms). The improved IAT scoring algorithm described by Greenwald et al was used to calculate the D measure for strength of automatic associations (see Supplementary Material S1 File for a detailed description on calculating D measures) (29). D measures above 0 indicated that HCPs or patients had relatively faster responses on the positive categorisation rounds than on negative categorisation rounds, and were interpreted as a relatively more positive than negative implicit attitude towards cDMARDs, or a relatively more health-related association than sickness-related association, and vice versa.

For explicit medication attitudes and associations, mean scale scores with standard deviation were calculated. Beliefs about medicines were operationalised as sum scale scores for necessity beliefs, sum scale scores for concern beliefs, and necessity-concerns differential (NCD) scores. NCD-scores were calculated by subtracting the sum of the item scores for concerns from the sum of item scores for necessity beliefs. A positive NCD indicated that necessity beliefs dominate concern beliefs, and vice versa (28,30). Medication-taking behaviour was operationalised as correct dosing (i.e. proportion of days with the correct number of doses taken). Self-reported medication-taking behaviour was calculated with the discriminant function for CQR items as described by de Klerk et al (31,32). Correct dosing measured with MEMS was calculated over time during three months follow-up based on device usage.

Depending on the distribution and type of variables, independent samples t-tests, Pearson chi-square tests, Fisher's exact tests, and proportion tests were performed to test for significant differences in HCP's characteristics between study sites. Spearman's rank correlations were used to describe the correlation between implicit and explicit outcomes of HCPs. Because of the explorative (rather than hypothesis-testing) character of this study, no multiple testing corrections were performed over the separate correlational analyses.

Due to the hierarchical structure of data (i.e. patients were nested in the sample of HCPs), linear multilevel regression models were built to assess the association of HCP's characteristics, implicit and explicit attitudes and health-related associations, and beliefs about medicines with: patient's implicit attitudes and health-related associations, patient's explicit attitudes and health-related associations, patient's necessity and concern beliefs, correct dosing measured with both self-report and MEMS, and disease activity scores. Bivariate analyses were performed to select the most important predictors to prevent overfitting of the model due to the large number of variables measured in this study. Determinants with P-values < 0.2 were entered in the final models. These final models were adjusted for the following patient-related variables: age, sex, level of education, household situation (i.e. living alone versus living together with at least one person), disease duration, anti-CCP status, hospital, and biologic DMARD use. Final models for correct dosing and disease activity scores were additionally adjusted for patient's necessity and concern beliefs

Ethical approval

This study was conducted according to the ethical principles for medical research as stated in the Declaration of Helsinki (64th WMA General Assembly, Fortaleza, Brazil, October 2013) and was approved by the Medical Research Ethics Committee of Arnhem-Nijmegen (File: 2016-2410)

Patient and public involvement

Two patient research partners were involved in the design phase of this study. Those patient research partners pretested the Single Category Implicit Association Tests and assessed the understandability of the hardcopy questionnaire for patients with rheumatoid arthritis.

Results

Study sample characteristics

Of the 43 initially invited rheumatologists and PAs, 26 HCPs agreed to participate in this study (overall response rate: 60.5%, Amsterdam: 47.4% and Nijmegen: 70.8%, see Figure 1). The majority of participants (92.3%) had a current position as rheumatologist and was male (69.2%). Participating HCPs had a mean age of 49.7 (SD=8.3) years with an average of 16.4 (SD=9.4) years of working experience. See Table 2 for a complete overview of HCP characteristics. Of the non-participating HCPs, 30.8% was male and 71.4% had a current position as rheumatologist. A total of 254 patients treated by these 26 different HCPs (overall response rate: 15.3%, Amsterdam: 15.0% and Nijmegen: 15.4%) agreed to participate in this study, which resulted in a number of patients per HCP varying from three to nineteen patients. Patients had a mean age of 62.8 (SD=11.2) years, 68.1% was female, 32.7% of the patients was highly educated, and 22.0% was living alone. Biologic DMARDs were prescribed to 32.7% of the patients and the mean disease duration of patients was 11.8 (SD=9.0) years. A more detailed description of all patient characteristics can be found in Supplementary Material S1 Table.

[Figure 1] [Table 2]

HCP's attitudes, health-related associations and beliefs

The mean D measure for implicit attitudes of HCPs was 0.045 (SD=0.41), whereas the mean D measure for implicit health-related associations was -0.037 (SD=0.36). The mean scale score for explicit attitudes (i.e. positive-negative) was similar to the mean scale score for explicit health-related associations (M= 3.8, SD=0.45, and M=3.9, SD=0.34 respectively). Regarding beliefs about medicines (necessity and concern beliefs), the mean sum scale score for HCP's necessity beliefs (M=20.9, SD=1.77) was higher than the mean sum scale for concern beliefs (M=11.5, SD=2.19). This resulted in a mean NCD-score for HCPs of 9.4 (SD=3.35), which indicates that necessity beliefs outweigh concern beliefs about cDMARDs.

No significant correlation was found between HCP's implicit attitudes and implicit health-related associations, nor between HCP's implicit and explicit attitudes and health-related associations. The same applied for implicit attitudes/ associations and NCD-scores ($\rho = -0.10$, $P=0.63$ and $\rho = 0.22$, $P=0.29$, respectively). This lack of association is illustrated in Figure 2. However, a significant correlation was found between HCP's explicit attitudes towards cDMARDs and their explicit health-related associations ($\rho = 0.48$, $P=0.01$).

[Figure 2]

Association of HCP's attitudes and beliefs about medicines with attitudes and beliefs of their patients

Table 3 provides an overview of the final multilevel linear regression models with patient's implicit and explicit outcomes as dependent variables. HCP-related factors, including socio-demographic characteristics, implicit and explicit attitudes and health-related associations together with explicit beliefs about medicines, were not significantly associated with patient's implicit and explicit outcomes. Only a few patient-related factors were significantly associated with patient's implicit and explicit outcomes. A high level of education of patients was significantly associated with more positive implicit attitudes towards cDMARDs compared to patients with a low to medium level of education (coefficient: 0.11, 95%CI:0.001; 0.22). Patient's age was significantly associated with patient's explicitly reported attitudes and health-related associations (coefficient: 0.01; 95%CI:0.002; 0.02 and coefficient: 0.01, 95%CI:0.001; 0.02 respectively), where older patients reported explicitly more positive attitudes and health-related associations than younger patients. Biologic DMARD users reported significantly higher sum scale scores for necessity beliefs than patients who were currently not treated with biologic DMARDs (coefficient: 1.25, 95%CI:0.30; 2.20). Patients who were living alone (coefficient: -1.25; 95%CI:-2.40; -0.11) or with a longer mean disease duration (coefficient: -0.07; 95%CI:-0.12;-0.02) reported significantly less concern beliefs than patients who are living together or had a short mean disease duration.

[Table 3]

Association of HCP's attitudes, associations and beliefs with medication adherence and disease activity scores

HCP-related factors, including socio-demographic characteristics, implicit and explicit attitudes and health-related associations together with beliefs about medicines, were not significantly associated with correct dosing and disease activity scores (see Supplementary Material S2 Table). However, patient's age, necessity beliefs and concern beliefs were significantly associated with self-reported correct dosing (coefficient: 0.02; 95%CI:0.01; 0.04, coefficient: 0.10; 95%CI:0.06; 0.15, and

coefficient: -0.05; 95%CI - 0.09; -0.002 respectively). Higher age and higher necessity beliefs were associated with higher scores for self-reported correct dosing, whereas higher concern beliefs were associated with lower scores for self-reported correct dosing. Patient's disease duration and necessity beliefs were significantly associated with correct dosing measured with MEMS (coefficient: -0.26; 95%CI:-0.48;-0.04 and coefficient: 0.61; 95%CI:0.04; 1.17 respectively). A relatively longer disease duration was associated with lower scores for MEMS correct dosing, whereas higher necessity beliefs were associated with higher scores for MEMS correct dosing. Sum scale scores for patient's concern beliefs were significantly associated with disease activity scores (coefficient: 0.04; 95%CI:0.003; 0.09), where more concerns were associated with higher disease activity scores.

Discussion

This study revealed that HCP-related factors, including socio-demographic characteristics, implicit and explicit attitudes and health-related associations together with explicit beliefs about medicines were not significantly associated with their patient's implicit and explicit attitudes and associations, as well as their patients' medication-taking behaviour and disease activity scores. Only a few patient-related factors were significantly associated with the outcome measures in this study: patient's age (outcome measures: self-reported correct dosing and patient's explicit attitudes and health-related associations), level of education (outcome measure: patient's implicit attitudes), household situation (outcome measure: patient's concern beliefs about medicines), disease duration (outcome measures: MEMS correct dosing and patient's concern beliefs about medicines), biologic DMARD use (outcome measure: patient's necessity beliefs about medicines), and sum scale scores for patient's necessity beliefs (outcome measure: MEMS correct dosing and self-reported correct dosing) and concern beliefs (outcome measures: self-reported correct dosing and patient's disease activity scores). Regarding medication-taking behaviour and disease activity scores, patient's necessity beliefs and concern beliefs were the only modifiable variables as possible targets for improving medication-taking behaviour and disease activity in patients with RA.

To our knowledge, this is the first study which investigates HCP's implicit and explicit associations with medication in the field of rheumatology. Although some research has been carried out on implicit attitudes of HCPs, previous studies have predominantly focused on implicit attitudes towards other concepts than medication or medication-taking behaviour (e.g. patients with mental illness, gender, racial bias and sexuality) (33–36). This makes it complex to compare our findings with previous work. Contrary to our expectations, HCP's attitudes, health-related associations and beliefs were not significantly associated with those of their patients, indicating that HCP's perception regarding medication seems independent from patients' perceptions and subsequent medication-taking behaviour. An explanation for this result might be that patient's attitudes, health-related associations and beliefs about medicines rely more on previous experiences with medication, whereas HCP's attitudes, health-related associations, and beliefs about medicines might rely more on recommendations based on scientific evidence. Another explanation is that a particular negative implicit or explicit attitude of HCPs against certain medication might influence other components of the patient-provider interaction rather than the outcomes measured in this study (e.g. style of communication, trust in the HCP and patient satisfaction). However, it is possible that HCP's implicit and explicit attitudes and health-related associations or beliefs about medication are associated with those of their patients, but were not detected in this study due to methodological limitations. This thought is in line with the study of Fitzgerald et al, which recognised the complexity to study the involvement of implicit outcomes in the patient-provider interaction due to methodological issues and the diversity in characteristics of both patients and HCPs (37).

Methodological considerations

One of the key strengths of this study is HCP and patient recruitment in two of the largest rheumatology specialized centres across the Netherlands, together with the large sample size of patients treated by these HCPs. Another strength is the use of electronic drug monitors to measure medication-taking behaviour of patients over a three-month period in addition to self-reported medication-taking behaviour. The use of multiple measurement instruments might, however, have contributed to an overestimation of adherence levels due to patient's awareness of being monitored and the small amount of variance in adherence measures. Together with the small amount of variance in explicit measures and the extensive working experience on the level of HCPs, this might have limited the possibility to detect potential influences of HCPs. The validity of the SC-IATs used for both study groups might be questioned since patients might have a limited hand function which is in contrast with HCPs. This might provide insufficient contrast between the experimental rounds in the SC-IATs on the level of patients, and large contrast between study groups. Also the design of the SC-IATs (i.e. words and pictures used as stimuli) might have influenced implicit outcomes since it is unclear if these words and pictures are optimally related to patient's medication use and the prescription of cDMARDs by HCPs. However, pictures were created based on pharmacy records in participating study sites (i.e. manufacturer of the drugs, type of packaging, and appearance of the drug) to increase the ability of patients and healthcare professionals to recognise the cDMARDs at a glance.

Generalisability of our findings

All HCPs who participated in this study were working in rheumatology specialised hospitals and reported extensive years of working experience. Therefore, caution must be applied for extrapolating our findings to HCPs who were working in more general hospitals or who were recently specialised in the field of rheumatology. Also, we have focused on cDMARDs only. It is, however, conceivable that HCP's implicit and explicit attitudes towards biologic DMARDs and the recently introduced JAK-inhibitors may differ from cDMARDs. On the level of patients, it is assumed that selection bias has occurred due to the large proportion of adherent patients, the small variety in ethnic background, the high percentage of patients who had a high level of education and a long disease duration. In adherence-research, the difficulty of recruiting patients who represent the general population is well recognised and often challenging (38,39).

In conclusion, HCP's implicit and explicit attitudes and associations with medication were not significantly associated with each other. Also, HCP's socio-demographic characteristics, implicit and explicit attitudes and associations, and beliefs about medicines were not associated with those of their patients, nor with correct dosing and patient's disease activity scores. These findings provide some first insights into the potential (and the lack thereof) of HCPs implicit and explicit medication perceptions in relation to patient's medication adherence and disease activity.

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Contributors

All authors meet the criteria for authorship.

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Competing interests

None declared.

Data sharing statement

All data relevant to the study are included in the article or uploaded as supplementary information. The primary data are available from the corresponding author upon reasonable request.

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Tables and figures

Table 1: Study overview: measurements of healthcare professionals (HCPs) and patients with heumatoid arthritis at baseline and follow-up. Inclusion and performing baseline measurements of healthcare professionals (HCPs) were completed before inclusion and performing baseline measurements of patients with rheumatoid arthritis (RA). The maximum follow-up period for patients was nine months.

	Baseline	Follow-up
Healthcare professionals	Implicit attitudes and health-related associations Socio-demographics Explicit attitudes and health-related associations Beliefs about medicines (i.e. necessity and concern beliefs about cDMARDs)	Not applicable
Patients	Implicit attitudes and health-related associations Socio-demographics Explicit attitudes and health-related associations Beliefs about medicines (i.e. necessity and concern beliefs about cDMARDs) Self-reported medication-taking behaviour Disease activity score (i.e. DAS28-CRP)	Medication-taking behaviour measured with Medication Event Monitoring Systems (MEMS, Aardex®) for a minimum period of three months.

Table 2 Characteristics of participating healthcare professionals in the field of rheumatology.

Characteristics of healthcare professionals	Nijmegen (N=17)	Amsterdam (N=9)	Overall (N=26)	P-value
Age, mean (SD), years	48.5 (8.7)	52.1 (7.4)	49.7 (8.3)	0.31
Female, N (%)	7 (41.2)	1 (11.1)	8 (30.8)	0.11
Current position				0.28
Rheumatologist, N (%)	15 (88.2)	9 (100)	24 (92.3)	
Physician assistant, N (%)	2 (11.8)	0 (0.0)	2 (7.7)	
Working experience, mean (SD), years	14.9 (9.6)	19.2 (8.7)	16.4 (9.4)	0.27
Hours patient contact per week, mean (SD)	18.4 (8.0)	25.3 (10.7)	20.8 (9.4)	0.07
Right-handed, N (%)	15 (88.2)	5 (55.6)	20 (76.9)	0.06

Table 3 Results multivariate multilevel linear regression models: predictors for patient's implicit and explicit attitudes and health-related associations, and beliefs about medicines. Reference level was 'no'(n) for predictors with yes (y)/ no (n)

	Patient's implicit attitudes	Patient's implicit health-related associations	Patient's explicit attitudes	Patient's explicit health-related associations	Patient's necessity beliefs about medicines	Patient's concern beliefs about medicines
	Coefficient (95%CI)	Coefficient (95%CI)	Coefficient (95%CI)	Coefficient (95%CI)	Coefficient (95%CI)	Coefficient (95%CI)
HCP-related factors						
Age, years	*	*	*	*	*	*
Sex, female (y/n)	*	*	*	*	*	*
Current position rheumatologist (y/n)	*	*	-0.13 (-0.54; 0.29)	0.19 (-0.32; 0.71)	*	-0.55 (-2.27; 1.17)
Working experience, years	*	*	-0.005 (-0.015; 0.006)	*	*	*
Mean hours of patient contact/ week	*	*	*	*	0.04 (-0.01; 0.10)	*
HCP's implicit and explicit attitudes and health-related associations						
Implicit attitudes, mean D measure	*	*	*	*	*	*
Implicit health-related associations, mean D measure	*	*	-0.19 (-0.46; 0.07)	-0.01 (-0.34; 0.32)	*	*
Explicit attitudes, mean scale score	*	*	0.09 (-0.20; 0.38)	0.24 (-0.12; 0.60)	0.34 (-0.86; 1.33)	-0.55 (-1.78; 0.69)
Explicit health-related associations, mean scale score	*	-0.09 (-0.21; 0.03)	0.12 (-0.20; 0.43)	0.11 (-0.29; 0.50)	1.02 (-0.31; 2.34)	*
HCP's beliefs about medicines						
Necessity beliefs, sum scale scores	*	*	-0.05 (-0.10; 0.007)	-0.02 (-0.09; 0.04)	0.10 (-0.16; 0.36)	*
Concern beliefs, sum scale scores	*	*	*	*	*	*
Patient-related factors						
Age, years	*	0.004 (-0.0004; 0.008)	0.01 (0.002; 0.02)	0.01 (0.001; 0.02)	*	*
Sex, female (y/n)	*	*	*	*	*	*
High level of education (y/n)	0.11 (0.001; 0.22)	0.08 (-0.02; 0.18)	*	*	*	*
Household situation, alone (y/n)	*	0.08 (-0.03; 0.19)	*	*	*	-1.25 (-2.40; -0.11)
Disease duration, years	*	*	*	*	0.04 (-0.01; 0.09)	-0.07 (-0.12; 0.02)
Anti-CCP positive (y/n)	*	*	*	*	*	*
Biologic DMARD (y/n)	-0.06 (-0.17; 0.05)	*	-0.06 (-0.25; 0.14)	-0.14 (-0.38; 0.09)	1.25 (0.30; 2.20)	*
Hospital Nijmegen (y/n)	*	*	*	*	*	-0.87 (-2.05; 0.31)

Figure 1. Study flow of participants: healthcare professionals and their treating patients with rheumatoid arthritis.

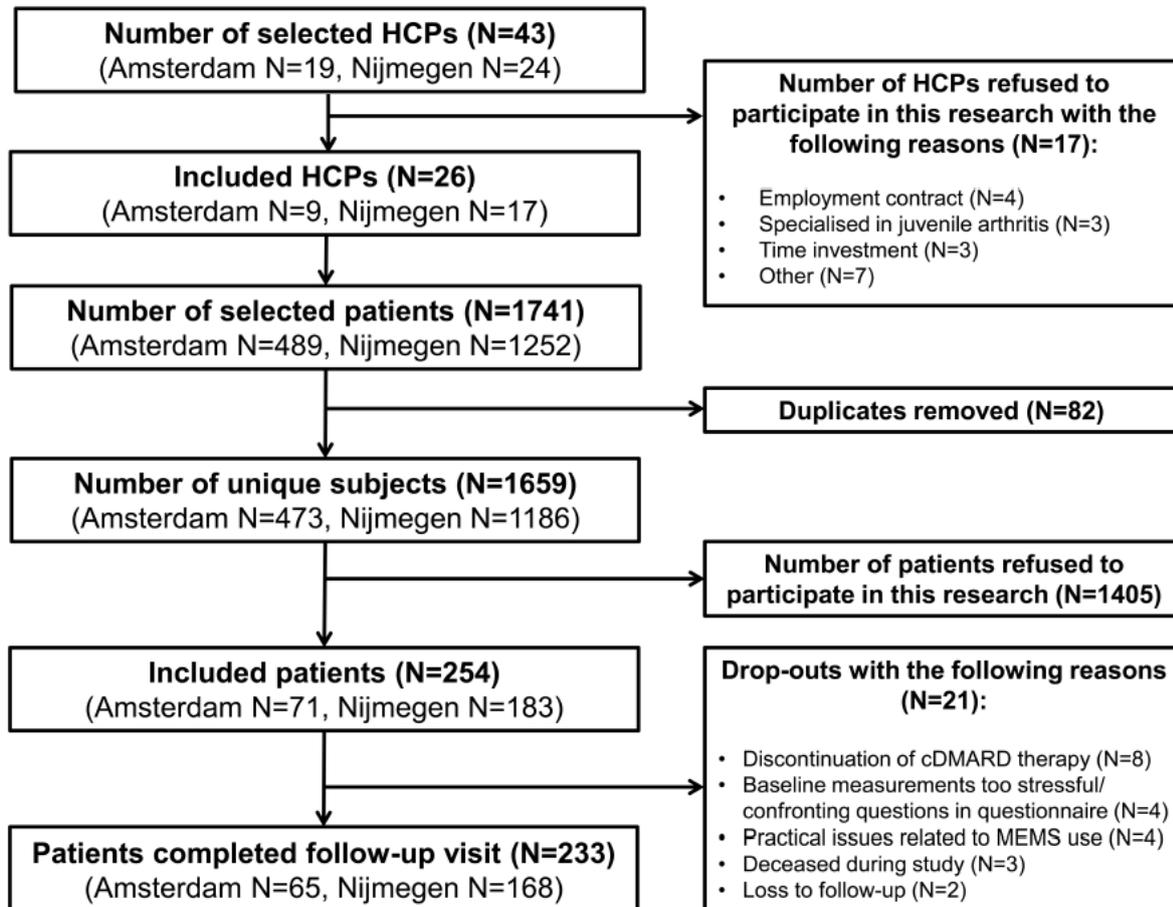


Figure 2. An illustration of the lack of association between implicit measures (i.e. SC-IAT concept for attitudes and health-related associations) and necessity-concerns differential scores of healthcare professionals.

