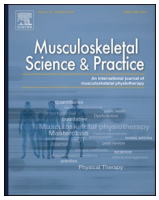
Musculoskeletal Science and Practice 57 (2022) 102496

Contents lists available at ScienceDirect

Musculoskeletal Science and Practice

journal homepage: www.elsevier.com/locate/msksp



Original article

Reliability of a self-administrated musculoskeletal questionnaire: The fourth Trøndelag health study

Astri Grøtan Dahl [a,1], Sara Havang [a,1], Knut Hagen [a,b,*]

[a] Department of Neuromedicine and Movement Science, Norwegian University of Science and Technology, Trondheim, Norway
[b] Clinical Research Unit Central Norway, St. Olavs Hospital, Trondheim, Norway

ARTICLE INFO

Keywords:
Epidemiology
Chronic pain
Prevalence
General population

ABSTRACT

Background: The reliability of the Nordic Musculoskeletal Questionnaire (NMQ) has not been evaluated in an unselected general population. The aim of this population-based follow-up study was to estimate the reliability between a self-administered NMQ-based questionnaire and a face-to-face interview performed approximately two months later. To interpret the results, we assessed the 1-year prevalence of various pain musculoskeletal pain locations.

Methods: A random sample of 1201 participants in the fourth wave of the Trøndelag Health Survey were invited to a follow-up interview focusing on sleep and pain. A total of 232 (19%) participated a semi-structured interview, and the agreement with the corresponding answers in the musculoskeletal questionnaire in HUNT4 were evaluated by Cohen's kappa statistics with 95% confidence interval (CI). The 1-year prevalence of the various pain sites was stratified by age and gender.

Results: The reliability was good for chronic musculoskeletal pain (CMSP), chronic widespread musculoskeletal pain (CWMSP) and pain in hip and knee (kappa values between 0.63 and 0.68). Moderate kappa values between 0.51 and 0.60 were found for pain in the neck, shoulder, elbow, wrist/hand, upper back, lower back, calf, ankle/feet, and ≥7 pain sites. The 1-year prevalence was 54.3% for CMSP and 17.2 for CWMSP, substantially higher for women and among those aged 50 years or more.

Conclusion: In this population-based study the reliability between interview and questionnaire was good to moderate for most pain locations. In particular, the self-administered musculoskeletal questionnaire seems to be a useful tool in identifying individuals with CMSP, CWMSP, and pain in hip and knee.

1. Introduction

Musculoskeletal disorders are ranked as one of the top ten causes of years lived with disability, most evident for lower back pain and neck pain (Global Burden of Disease, 2016). Musculoskeletal conditions constitute a major problem for the individuals affected and for the society with high economic burden for most countries in Europe (Woolf et al., 2012).

In recognition of this high impact on health, epidemiological studies may increase our knowledge of musculoskeletal disorders in the general population. While musculoskeletal conditions are most accurately diagnosed by a careful patient history combined with clinical examination and supplementary investigations (Yazici and Gibofsky, 1999), questionnaires are most often used in large-scale population-based studies with limited ability to make specific diagnoses of musculoskeletal pain. On the other hand, the use of standardized questionnaire in large-scale population-based studies is an effective and inexpensive strategy to identify individuals and evaluate the impact of chronic musculoskeletal pain (CMSP).

The standardized Nordic musculoskeletal Questionnaire (NMQ) was developed in the last part of 1980s (Kuorinka et al., 1987). During the last three decades NMQ is commonly used, in many clinical (e.g. López-Aragón et al., 2017) and in many Scandinavian population-based studies (Andersson et al., 1993; Bergman et al., 2001; Sirnes et al., 2003; Svebak et al., 2006; Hagen et al., 2011; Andorsen et al., 2014). The reliability of NMQ have been evaluated in several selected groups with a

* Corresponding author. Department of Neuromedicine and Movement science Faculty of Medicine, Norwegian University of Science and Technology, 7489, Trondheim, Norway.
E-mail address: knut.hagen@ntnu.no (K. Hagen).
[1] Shared first authorship.

https://doi.org/10.1016/j.msksp.2021.102496
Received 4 July 2021; Received in revised form 8 December 2021; Accepted 14 December 2021
Available online 16 December 2021

short interval between test-retest (e.g. Kuorinka et al., 1987; Palmer et al., 1999; Pugh et al., 2015; Namnik et al., 2016; Yona et al., 2020; Gómez-Rodríguez et al., 2020). Although the NMQ is widely used in epidemiological studies, no previous studies have evaluated the reliability of specific body locations of CMSP in an unselected group of participants in a large population-based study.

The aim of this longitudinal population-based study was to evaluate the reliability of single and multiple musculoskeletal pain sites between a self-administered questionnaire and a face-to-face interview performed approximately two months later. To better interpret the results, we also report the 1-year prevalence of the corresponding pain locations based on the face-to-face interview.

2. Materials and methods

2.1. The fourth Trøndelag Health Survey (HUNT4)

The Trøndelag Health Study (HUNT) is one of the largest population-based surveys ever performed and have been conducted in four waves between 1984 and 2019 (Krokstad et al., 2013). In the adult version of HUNT4 performed in the period between September 2017 and March 2019 all inhabitants aged 20 years or more in Nord-Trøndelag county of Norway were invited to participate. The HUNT4 survey included two questionnaires; questionnaire 1 (Q1) and questionnaire 2 (Q2), where Q2 contained a musculoskeletal questionnaire mainly adopted from the original NMQ supported by the Nordic Council of Ministers, and was initially translated into four Nordic languages, including Norwegian (Kuorinka et al., 1987). The current Norwegian version included the original screening question and the drawing, and compared to the original NMQ, check boxes for jaw, chest, calf and thigh were added in HUNT4, increasing the total number of pain locations from 9 included in HUNT2 and HUNT3 to 13 in HUNT4 (Fig. 1). As demonstrated by Fig. 1, the participants should answer "yes" or "no" on the screening question, and those who responded "yes" were asked to tic of one or more (maximum 13) pain locations on the drawing.

Among 96,396 invited adult aged ≥20 years in HUNT4, a total of 50,078 (58%) answered Q1, whereof 41,643 (44%) individuals answered Q2 (Fig. 2).

2.2. HUNT4 sleep and pain study

The present study is a part of a subproject of HUNT4 called "sleep and pain study" mainly focusing on sleep disorders and including invitation to ambulatory polysomnography (PSG) and neurophysiological measurements (Hagen et al., 2018, 2019; Filosa et al., 2021). A random sample of HUNT4 participants received an invitation letter sent by postal mail and informing about an initial interview focusing on sleep disorders. Questions about musculoskeletal pain were not mentioned in the invitation letter.

2.3. Study population

The main goal with the "sleep and pain study" was to perform at least 200 PSGs. Based on a participation rate of <20% in the HUNT3 PSG-study (Uhlig et al., 2019), it was decided to send 1201 postal written invitations randomly to adult HUNT4 participants living in Stjørdal who had participated in HUNT4 in the period from September 4th' 2017 to November 30th' 2017. They should all have had responded to both HUNT questionnaires. No stratification by sex or age was performed. However, based on previous experience with HUNT3 (Uhlig et al., 2019), we anticipated that participation would be higher among women than men, highest in the age group 60–69 years, and lowest in the age group 20–29 years.

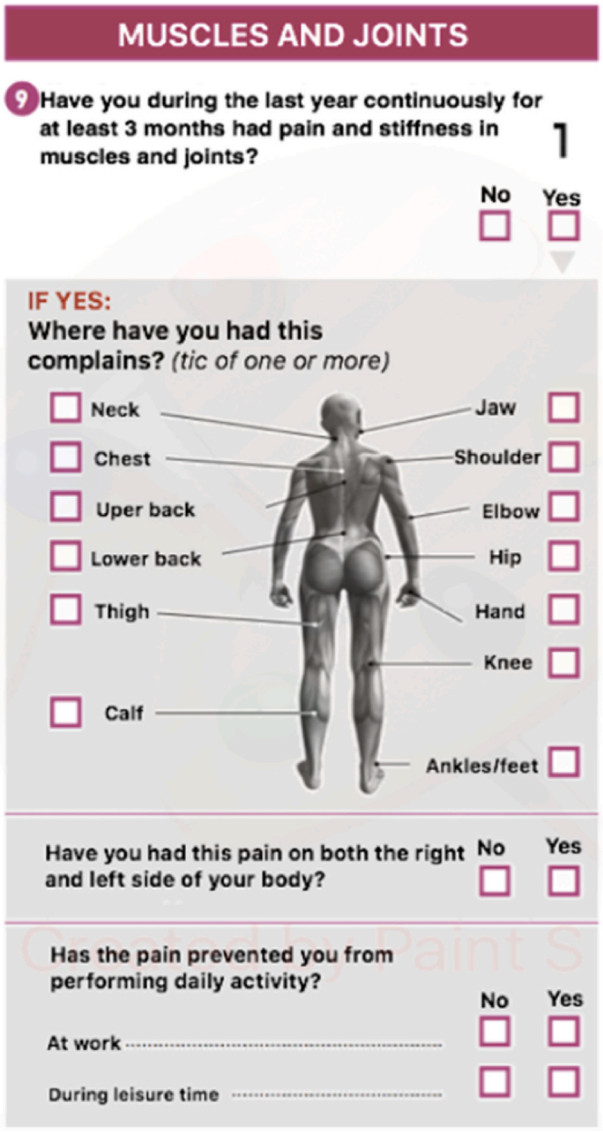


Fig. 1. English translation of musculoskeletal questions included in the scond questionnare of HUNT4 and replicated in the semi-structured interview.

2.4. The semi-structured interview

The semi-structured interviews were conducted for an average of two months after they had answered the questionnaire and performed by five medical doctors (three neurologists and two junior doctors) with special interest and competence of headache and pain disorders (Hagen et al., 2018, 2019). The interview questions were a copy of the musculoskeletal questions included in the Q2 of HUNT4 (Fig. 1). The participants were initially asked the screening question "During the last year, have you had pain and stiffness in your muscles and joints that lasted for at least three consecutive months?" Those who answered "yes" were classified as having CMSPs, and they were also asked to mark the localization(s) in a drawing (Fig. 1), with the following 13 options: jaw, neck, shoulder, elbow, wrist/hand, chest, upper back, lower back, hip, knee, ankles/feet, tight and calf. During the semi-structured interview, the participants with CMSP were asked whether consultations and supplementary investigations (e.g., blood tests and imaging studies), had ended in a doctor-evaluated specific diagnosis.

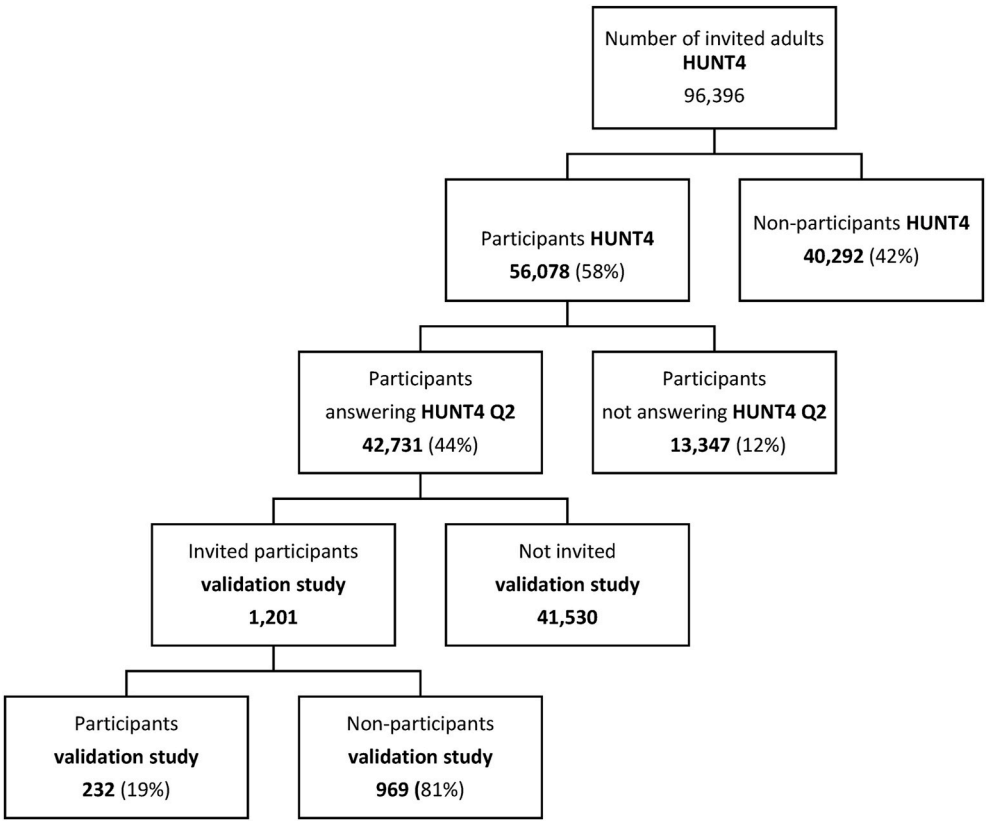


Fig. 2. Diagram of the invited population according to type of participation in HUNT4.

2.5. The definition of chronic widespread musculoskeletal pain

Chronic widespread musculoskeletal pain (CWMSP) was defined according to the 1990 criteria of the American College of Rheumatology (ACR) and included the pain in both sides of the body and CMSP from all of the following three regions: axial skeleton (neck, chest, upper back or lower back), above the waist (neck, shoulder, elbow, wrist/hand, chest or upper back) and below the waist (lower back, hip, knee or ankles/feet) (Wolfe et al., 1990). Furthermore, we also made separate analyses for individuals having respectively 3–6 and ≥7 pain sites with specific relevance with the revised fibromyalgia 2016 criteria (Wolfe et al., 2016).

2.6. Missing data

In the interview, two participants had missing data on the screening question. In the present study, they were both recoded to answering "no" based on negative response on the subsequent 13 pain questions.

2.7. Ethics

This study was approved by the Regional Committee for Ethics in Medical Research (#2018/2422/Rek Midt). The participants have given written informed consent. The HUNT4 project was also approved by the Norwegian Data Inspectorate.

2.8. Statistics

The reliability between questionnaire and interview for the corresponding CMSP locations were evaluated by Cohen's kappa statistics with 95% CI. A kappa value of ≤0.20 is considered as poor, between 0.21 and 0.40 as fair, between 0.41 and 0.60 as moderate, between 0.61 and 0.80 as good, and between 0.81 and 1.00 as very good (Altman, 1991). The correlation between the total number of pain sites (0–13) reported in the questionnaire and interview was calculated by Spearman's rank correlation coefficient with 95% CI. The 1-year prevalence of the various pain sites was estimated with 95% confidence interval (CI) stratifying for gender and for the age groups below 50 years and 50 years and above. IBM SPSS version 26 (Chicago, IL, USA) was used for the analyses.

3. Results

3.1. Descriptive data of the study population

Of the 1201 randomly invited participants, 239 agreed to participate. Seven people could not attend the face-to-face interview because they were out of town, had a sick husband, were busy at work or had forgotten the invitation. A total of 232 underwent a semi-structured interview (19% participation rate) (Fig. 1). Among the 232 participants, 15 did not answer the screening question in the second questionnaire in HUNT4. Thus, 217 participants were included in the reliability analyses, whereas all 232 participants were included in the prevalence estimates.

As demonstrated in Table 1, more women (65%) than men (35%) participated in the interview (n = 232). A total of 115 (50%) had ≥13 years of education, and 75 (32%) were full-time workers. Mean BMI was 27.3 kg/m^2 and mean age 58.4 years (range, 22–89 years). Individuals aged between 20 and 39 years were less likely to participate, and 70% were in the age group 50–79 years (Table 1). Accordingly, the mean age was 57.8 years in the group of 217 persons (65% women and 69% aged 50–79 years) who had completed with the self-administrated questionnaire in HUNT4.

Table 1
Characteristics of the population participating in the interview (n = 232).

	Women n = 151	Men n = 81	Total n = 232
Sex (%)	65.1	34.9	100
Education level ≥13 years	65	50	115
Full-time workers	42	33	75
Mean BMI[a], kg/m^2	27.0	27.7	27.3
Total HADS^2 score	9.9	9.4	9.7
Mean age, years	57.5	60.1	58.4
Age range	22–83	23–89	22–89
Age groups, years			
20–29	6	4	10
30–39	13	4	17
40–49	26	7	33
50–59	32	20	52
60–69	37	23	60
70–79	4	19	50
80–89	6	4	10

[a] BMI = Body mass index 2. HADS=Hospital Anxiety and Depression Scale.

3.2. Reliability between the self-administrated questionnaire and the interview

The mean time interval between answering the self-administrated Q2 questionnaire in HUNT4 and attending the interview was 59 days (95% CI 56–62 days). As demonstrated by Table 2, the calculated kappa values ranged from 0.21 to 0.68. The kappa values were found to be good for CMSP (0.64, 95% CI 0.54–0.74), CWMSP (0.63, 95% CI 0.50–0.76) and pain in the hip (0.67, 95% CI 0.55–0.79) and knee (0.68, 95% CI 0.56–0.78). Kappa values ≥ 0.51 were found for pain the neck, shoulder, elbow, wrist/hand, upper back, lower back, calf, ankle/feet, and ≥7 pain sites (Table 2). The lowest estimated agreement between questionnaire and interview was found for pain in the chest and thigh, and for 1–2 pain sites and 3–6 pain sites, with kappa values ranging from 0.21 to 0.33 (Table 2). A strong correlation between the questionnaire and the interview regarding total number of pain sites was found (Spearman's rank correlation coefficient 0.72, 95% CI 0.65–0.78).

Table 2
Reliability measured by kappa values with 95% confidence intervals comparing various musculoskeletal pain locations based on questionnaire and interview (n = 217).

Pain location	Interview (n)	Quesionnaire (n)	False Positive	False Negative	Kappa values with 95% CI
CMSP[a]	116	119	21	18	0.64 (0.54–0.74)
Jaw	11	17	10	4	0.47 (0.23–0.70)
Neck	48	66	29	11	0.53 (0.40–0.65)
Shoulder	47	67	27	7	0.60 (0.48–0.72)
Elbow	28	29	12	11	0.54 (0.38–0.70)
Chest	12	10	6	8	0.33 (0.07–0.59)
Wrist/ hand	48	56	24	13	0.52 (0.39–0.66)
Upper back	28	32	13	9	0.58 (0.42–0.73)
Lower back	44	62	29	11	0.51 (0.37–0.64)
Hips	44	48	14	10	0.67 (0.55–0.79)
Knee	51	52	13	12	0.68 (0.56–0.78)
Ankle/ feet	42	49	18	11	0.60 (0.47–0.73)
Thigh	25	17	11	19	0.21 (0.02–0.40)
Calf	29	24	9	14	0.51 (0.33–0.68)
CWMSP[b]	37	51	20	6	0.63 (0.50–0.76)
3-6 pain sites	42	51	29	20	0.33 (0.18–0.48)
≥7 pain sites	21	29	14	6	0.55 (038.-0.72)

[a] CMSP: Chronic musculoskeletal pain (screening question).
[b] CWMSP: Chronic widespread musculoskeletal pain according to ACR 1990 criteria.

3.3. One-year prevalence of chronic musculoskeletal pain (CMSP)

The overall 1-year prevalence of CMSP was 54.3% (95%CI 47.9–60.8) and of CWMSP 17.2% (95% CI 12.3–22.1) (Table 3). Among the 126 individuals with CMSP, 101 (80%) had unspecified pain, whereas the remaining 25 persons (20%) reported a doctor-evaluated diagnosis in the semi-structured interview; e.g. arthrosis (n = 13), fibromyalgia (n = 6) or other specified diagnoses like rheumatoid arthritis and spinal stenosis (n = 6).

As demonstrated by Table 3, the highest 1-year prevalence of pain was localized in knee (23.7%), shoulder (22.4%), hip (22.0%), neck (21.5%), wrist/hand (20.7%), and lower back (20.7%), whereas the lowest prevalence was found for pain in the chest (5.6%) and jaw (4.7%). The 1-year prevalence were almost consistently higher for women compared to men, most evident for pain in the neck, shoulder, wrist/hand, upper back, hip, and ankle/feet (Table 3). For example, 23.8% of women and 4.9% of men reported pain in the ankle/feet (Table 3). Furthermore, women were more likely to have ≥7 pain sites than men (14.6% versus 1.2%). On the other hand, more men than women reported less than three pain sites (33.3% versus 19.2%). Regarding the impact of age, higher 1-year prevalence of various pain locations were found for individuals aged 50 years and above than for those below 50 years of age, except for pain in the neck, shoulder, elbow, and upper back (Table 3).

4. Discussion

In this first follow-up study of an unselected population, we evaluated the reliability between an NMQ-based questionnaire and a face-to-face interview using a recommended design (Dunn, 1992). In line with previous clinical-based studies evaluating the reliability of the NMQ (Kuorinka et al., 1987; Palmer et al., 1999; Pugh et al., 2015; Namnik et al., 2016; Yona et al., 2020; Gómez-Rodríguez et al., 2020), the change-corrected agreement between interview and questionnaire was good (kappa value ≥ 0.60) or moderate with kappa values ≥ 0.51 for most pain locations.

Identical kappa value (0.63) of CWMSP was found in the present study and in HUNT3 based on interview of 293 of HUNT3 participants, whereas a higher kappa value was found for CMSP in the present study (0.64) compared to the corresponding HUNT3 study (0.48) (Hagen et al., 2011). The reason for the better kappa value for CMSP in HUNT4 is unclear. However, it should be mentioned that the 293 persons who participated in the reliability study in HUNT3 were younger (mean age 52.3 vs. 58.4 years) and more likely to be men (51% versus 35%) compared to the present study population. Speculatively, lower occurrence of CMSP in the reliability study of HUNT3 compared to HUNT4 may, at least in part, explain the lower agreement reported in HUNT3.

A kappa value ≥ 0.61 was also found for pain in the hip and knee, and kappa values ≥ 0.51 were found for pain in the neck, shoulders, elbows, wrist/hand, calf, upper and lower back, and for ≥7 pain sites. These results are in accordance with a previous clinical-based study reporting good reliability (kappa values between 0.63 and 0.90) of the upper body (Palmer et al., 1999). Based on these results, we may suggest that the self-administered musculoskeletal questionnaire seem to be a useful tool for all these pain locations. On the other hand, only fair agreement was found or pain in the thigh, chest and for 3–6 pain sites,

Table 3
One-year prevalence with 95% confidence intervals of multiple musculoskeletal pain locations separated by age and gender.

Pain location	Number	<50 years of age (n = 60)	≥50 years of age (n = 172)	Men (n = 81)	Women (n = 151)	Overall (n = 232)
CMSP[a]	126	51.7 (38.7–64.7)	55.2 (47.7–62.7)	45.0 (33.9–56.1)	58.9 (51.0–66.9)	54.3 (47.9–60.8)
Jaw	11	0	6.4 (2.7–10.1)	0	7.3 (3.1–11.5)	4.7 (2.0–7.5)
Neck	50	25.0 (13.7–36.3)	20.4 (14.3–26.4)	9.9 (3.2–16.5)	27.8 (20.6–35.0)	21.6 (16.2–26.9)
Shoulder	51	23.3 (12.3–33.4)	21.5 (15.3–27.7)	11.1 (4.1–18.1)	27.8 (20.6–35.0)	22.4 (17.1–27.8)
Elbow	30	13.3 (4.5–22.2)	12.8 (7.8–17.8)	6.2 (0.8–11.5)	16.6 (10.6–22.6)	12.9 (8.6–17.3)
Chest	13	5.0 (0.0–10.7)	5.8 (2.3–9.4)	1.2 (0.0–3.7)	8.0 (3.6–12.3)	5.6 (2.6–8.6)
Wrist/hand	48	18.3 (8.3–28.4)	21.5 (15.3–27.7)	7.4 (1.6–13.2)	27.8 (20.6–35.0)	20.7 (15.4–25.9)
Upper back	29	15.0 (5.7–24.3)	11.6 (6.8–16.5)	2.5 (0.0–5.9)	17.9 (11.7–24.1)	12.5 (8.2–16.8)
Lower back	48	16.7 (7.0–26.4)	22.1 (15.8–28.4)	14.8 (6.9–22.7)	23.8 (17.0–30.7)	21.1 (15.8–26.4)
Hips	51	15.0 (5.7–24.3)	24.4 (17.9–30.9)	8.6 (2.4–14.9)	29.1 (21.8–36.5)	22.0 (16.6–27.4)
Knee	55	13.3 (4.5–22.2)	27.3 (20.6–34.1)	17.3 (8.9–25.7)	27.2 (20.0–34.3)	23.7 (18.2–29.2)
Ankle/feet	45	11.7 (3.3–20.0)	22.1 (15.8–28.4)	9.9 (3.2–16.5)	24.5 (17.6–31.4)	19.4 (14.3–24.5)
Thigh	27	10.0 (2.2–17.8)	12.2 (7.3–17.2)	2.5 (0.0–5.9)	16.6 (10.6–22.6)	11.6 (7.5–15.8)
Calf	32	11.7 (3.3–20.0)	14.5 (9.2–19.9)	7.4 (1.6–13.2)	17.2 (11.1–23.3)	13.8 (9.3–18.3)
CWMSP[b]	40	15.0 (5.7–24.3)	18.0 (12.2–23.8)	4.9 (0.1–9.8)	23.8 (17.0–30.7)	17.2 (12.3–22.2)
1-2 pain sites	56	23.3 (12.3–34.4)	24.4 (17.9–30.9)	33.3 (22.8–43.8)	19.2 (12.9–25.6)	24.1 (18.6–29.7)
3-6 pain sies	47	21.7 (10.9–32.4)	19.8 (13.8–25.8)	11.1 (4.2–18.1)	25.2 (18.2–32.2)	20.3 (15.1–25.5)
≥7 pain sites	23	6.7 (0.2–13.2)	11.1 (6.3–15.8)	1.1 (0.0–3.7)	14.6 (8.9–20.3)	9.9 (6.0–13.8)

[a] CMSP: Chronic musculoskeletal pain.
[b] CWMSP: Chronic widespread musculoskeletal pain according to ACR 1990 criteria.

respectively. The good agreement for ≥7 pain sites and only fair agreement for 3–6 pain sites are of relevance for the revised fibromyalgia 2016 criteria (Wolfe et al., 2016). Thus, the interpretation of questionnaire-based diagnosis of fibromyalgia using 3–6 pain sites should be done with great caution. It should be highlighted that the pain locations jaw, thigh, and calf were not a part of the NMQ and were included in the questionnaire for the first time in HUNT4.

Several studies have adopted versions of the NMQ to other languages and cultures and analyzed the reliability of these questionnaires in different selected groups (Dawson et al., 2009; Legault et al., 2014; Pugh et al., 2015; Kahraman et al., 2016; Namnik et al., 2016; Alaca et al., 2019; Gómez-Rodríguez et al., 2020). Most of them have performed a test-retest reliability analysis, were the same participants answered the same questionnaire twice with or without a certain time interval in between. The interval between answering the questionnaire twice varies from study to study from a mean time of hours/days to a few weeks (Dawson et al., 2009; Legault et al., 2014; Pugh et al., 2015; Kahraman et al., 2016; Namnik et al., 2016; Alaca et al., 2019; Gómez-Rodríguez et al., 2020). These test-retest studies have all found moderate to excellent reliability (kappa values ranging from 0.57 to 1.0). In the present study the mean time-interval between answering the questionnaire and participating in the interview was nearly 2 months. Hence, the long re-test interval may possibly give a greater risk of changed in pain status for each participant which may reduce the agreement between questionnaire and interview. Stable pain symptoms are more likely with a shorter time interval, in particular for localized pain sites. On the other hand, longer re-test intervals than days or a few weeks may also reduce the risk of a memory effect where recall of previous answers can influence the reliability (Dawson et al., 2009). Furthermore, it should be highlighted that the screening question asked about pain for *at least three consecutive months during the last year*. Thus, change in chronic MSC pain status during the next period are probably less likely. However, change of localized pain e.g. in chest and thigh are more common, impacting the degree of agreement between questionnaire and interview.

4.1. Prevalence of musculoskeletal pain

In the present study the overall prevalence of CMSP was 54.3% and of CWMSP 17.2%, and even higher figures were found for those aged ≥50 years and among women. Interestingly, only 20% of those with CMSP reported having a doctor diagnosis explaining their pain, indicating that 80% have unspecified musculoskeletal pain.

Several population-based Scandinavian studies have used the same definition of CMSP and CWMSP as in the present study (Andersson et al., 1993, Bergman et al., 2001; Sirnes et al., 2003; Svebak et al., 2006; Hagen et al., 2011). In a prospective study performed in Tromsø in Norway from 1994 to 1995, the 1-year prevalence of CMSP and CWMSP were respectively 35.7% and 12.8% (Andorsen et al., 2016). In the same period in the Nord-Trøndelag County of Norway, the corresponding prevalence were 44.8% and 22.0% based on data from 64,490 participants in HUNT2 aged 20 years or older (Hagen et al., 2011). Furthermore, the 1-year prevalence of CMSP and CWMSP in Sweden were 34.5% and 11.4%, respectively, substantially lower than our findings (Bergman et al., 2001). Later, in HUNT3 (2006–8), the prevalence of CMSP and CWMSP were estimated to be 47.9% and 20.0% respectively (Hagen et al., 2011).

In the present study, pain located in the knee, hip, shoulder, and neck were the most the prevalent location of CMSP. In accordance, highest prevalence of pain the neck- and shoulder-region were also reported in other population-based studies (Andersson et al., 1993; Wijnhoven et al., 2006; Hagen et al., 2011; Andorsen et al., 2014).

We found higher prevalence of CMSP among individuals aged 50 years and above than among those below 50 years, in accordance with many other population-based studies (e.g. Bergman et al., 2001; Hagen et al., 2011; Andorsen et al., 2014). Furthermore, a peak in those aged 50–59 years was reported in a Swedish survey (Andersson et al., 1993). Men were more likely to report 1–2 pain locations, whereas the opposite was found for 3–6 and ≥7 pain locations. Similarly, other population-based studies have found that women are more likely to have more severe or extensive musculoskeletal complaints compared to men (Wijnhoven et al., 2006; Andorsen et al., 2014).

Overall, estimated prevalence of CWMSP from other studies in Europe using the ACR criteria varies from 4.2% to 23.9% (Wolfe et al., 1995; Lindell et al., 2000; Bergman et al., 2001; McBeth et al., 2010). That leaves our estimation of CWMSP of 17.2% in the higher range compared to the other studies. Notably, in HUNT2, as the questionnaire did not include "pain in both sides of the body"-option, the definition of CWMSP used in prevalence estimations in HUNT2 and HUNT3 did not acquire this (Hagen et al., 2011). In example, the prevalence of CWMSP in HUNT3 increased from 20.0% to 23.6% not including "pain both sides of the body" option (Hagen et al., 2011). Accordingly, the prevalence of CWMSP in our study increased from 17.2% to 19.8% without including this option. During the last decades, some studies in Europe suggest the stable, but high prevalence of CMSP (Sjøgren et al., 2009), whereas other large-scale population-based studies have reported a trend of increasing prevalence of CMSP and CWMSP (Jiménez-Sánchez et al., 2010; Hagen et al., 2011). Accordingly, comparing the overall 1-year prevalence of CMSP in HUNT2 (44.8%), HUNT3 (47.9%) and the

present HUNT4 sub-study (54.3%), an increasing trend may be assumed. It should be highlighted that the present study was performed one year before the covid-19 pandemic outbreak. Interestingly, an increasing trend in the occurrence of CMSP and CWMSP have been suggested because of the covid-19 pandemic (Memari et al., 2020). Regarding this prediction, it may be of relevance that the use of computers and digital meetings have become more frequent than during the pandemic period, and computer- and mobile-usage has been associated with musculoskeletal pain (Punamäki et al., 2007). Thus, future population-based studies performed after the outbreak of covid-19 pandemic will be of particular interest regarding occurrence of CMSP.

4.2. Study strengths and limitations

The strengths of this study were the population-based study design inviting a random sample of participants, the use of semi-structured interview performed by doctors with special competence of pain disorders, and that the majority of questions included in the interview and questionnaire was based on NMQ. The random invitation reduces the risk for selection bias.

Furthermore, the invitations to the sub-study did not mention that the interview would contain questions considering musculoskeletal pain. This gives a lower risk of selection bias toward people with special interest in musculoskeletal pain. The present study included 232 participants. For the reliability analysis, Altman recommend at least 50 subjects for evaluation of the measures (Altman, 1991). Other studies testing validity and reliability of the NMQ have included from 39 to 312 participants ((Dawson et al., 2009; Legault et al., 2014; Pugh et al., 2015; Kahraman et al., 2016; Namnik et al., 2016; Alaca et al., 2019; Gómez-Rodríguez et al., 2020). Hence, we can say that our study is in the higher range of number of participants compared to other reliability studies.

There are limitations that must be considered. Most participants were aged 50–79 years and a higher number of women than men agreed to attend. The interviews were performed during daytime, which may make the working population less likely to attend the interviews. Because female gender and older age are more likely to suffer from CMSP, this might contribute to an overestimation of the overall 1-year prevalence figures in our study. In addition, the subproject mainly focused on sleep disorders. The population had an overrepresentation of individuals with insomnia (Filosa et al., 2021), which may be a result of interest-related participation. Thus, we could not rule out the possibility that this selection bias could have interfered with the prevalence rates of musculoskeletal pain.

Other population-based questionnaire-based studies estimating prevalence of CMSP in Norway have included several thousand participants and had participation rates of 42–69% (Sirnes et al., 2003; Hagen et al., 2011; Andorsen et al., 2014). Hence, generalization of our prevalence figures should be done with caution considering the very low participation rate of 19%. In addition, our relatively low sample size of 232 participants, gave relatively wide confidence intervals of our prevalence estimates. Finally, as mentioned above, the time interval between the questionnaire and interview was approximately 2 months which may have reduced the possibility of stable pain symptoms, impacting the level of agreement.

5. Conclusions

In this first population-based follow-up study evaluating reliability, the self-administrated NMQ-based HUNT4 musculoskeletal questionnaire was found to have moderate to good reliability for most pain locations. In particular, the questionnaire seems to be a useful tool to identify CMSP, CWMSP and pain in the hip and knee. Only fair agreement was found for pain in the chest and thigh as well as for 3–6 pain locations. Thus, interpretation of these locations should be done with caution.

Acknowledgements

The Trøndelag Health Study (HUNT) (The HUNT Study) is a collaboration between HUNT Research Centre, (Faculty of Medicine and Health Sciences, NTNU, Norwegian University of Science and Technology), Trøndelag County Council, Central Norway Regional Health Authority, and the Norwegian Institute of Public Health.

References

Alaca, N., Safran, E.E., Karamanlargil, A.İ., Timucin, E., 2019. Translation and cross-cultural adaptation of the extended version of the Nordic musculoskeletal questionnaire into Turkish. J. Musculoskelet. Neuronal Interact. 19, 472–481.

Altman, D.G., 1991. Inter-rater Agreement: Practical Statistics for Medical Research, first ed. Chapman & Hall, London, UK.

Andersson, H.I., Ejlertsson, G., Leden, I., Rosenberg, C., 1993. Chronic pain in a geographically defined general population: studies of differences in age, gender, social class, and pain localization. Clin. J. Pain 9, 174–182. https://doi.org/10.1097/00002508-199309000-00004.

Andorsen, O.F., Ahmed, L.A., Emaus, N., Klouman, E., 2014. High prevalence of chronic musculoskeletal complaints among women in a Norwegian general population: the Tromsø study. BMC Res. Notes 7, 506. https://doi.org/10.1186/1756-0500-7-506.

Andorsen, O.F., Ahmed, L.A., Emaus, N., Klouman, E., 2016. Musculoskeletal complaints (pain and/or stiffness) and their impact on mortality in the general population. The tromso study. PLoS One 11 (10), e0164341. https://doi.org/10.1371/journal.pone.0164341.

Bergman, S., Herrström, P., Hogstrom, K., Petersson, I.F., Svensson, B., Jacobsson, L.T., 2001. Chronic musculoskeletal pain, prevalence rates, and sociodemographic associations in a Swedish population study. J. Rheumatol. 28 (6), 1369–1377.

Dawson, A.P., Steele, E.J., Hodges, P.W., Stewart, S., 2009. Development and test–retest reliability of an extended version of the nordic musculoskeletal questionnaire (NMQ-E): a screening instrument for musculoskeletal pain. J. Pain 10, 517–526. https://doi.org/10.1016/j.jpain.2008.11.008.

Dunn, G., 1992. Design and analysis of reliability studies. Stat. Methods Med. Res. 1 (2), 123–157.

Filosa, J., Omland, P., Langsrud, K., Hagen, K., Engstrøm, M., Drange, O.K., Knutsen, A. J., Brenner, E., Kallestad, H., Sand, T., 2021. Validation of insomnia questionnaires in the general population: the HUNT study. J. Sleep Res. 30 (1), e13222 https://doi.org/10.1111/jsr.13222.

Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 388 (10053), 2016, 1545–1602. https://doi.org/10.1016/S0140-6736(16)31678-6.

Gómez-Rodríguez, R., Díaz-Pulido, B., Gutiérrez-Ortega, C., Sánchez-Sánchez, B., Torres-Lacomba, M., 2020. Cultural adaptation and psychometric validation of the standardised nordic questionnaire Spanish version in musicians. Int. J. Environ. Res. Publ. Health 17 (2), 653. https://doi.org/10.3390/ijerph17020653.

Hagen, K., Linde, M., Heuch, I., Stovner, L.J., Zwart, J.A., 2011. Increasing prevalence of chronic musculoskeletal complaints. A large 11-year follow-up in the general population (HUNT 2 and 3). Pain Med. 12, 1657–1666. https://doi.org/10.1111/j.1526-4637.2011.01240.x.

Hagen, K., Åsberg, A.N., Uhlig, B.L., Tronvik, E., Brenner, E., Stjern, M., Helde, G., Gravdahl, G.B., Sand, T., 2018. The epidemiology of headache disorders: a face-to-face interview of participants in HUNT4. J. Headache Pain 19, 25. https://doi.org/10.1186/s10194-018-0854-2.

Hagen, K., Åsberg, A.N., Uhlig, B.L., Tronvik, E., Brenner, E., Sand, T., 2019. HUNT4: the validity of questionnaire-based diagnoses. J. Headache Pain 20, 70. https://doi.org/10.1186/s10194-019-1021-0, 2019.

Jiménez-Sánchez, S., Jiménez-García, R., Hernández-Barrera, V., Villanueva-Martínez, M., Ríos-Luna, A., Fernández-de-las-Peñas, C., 2010. Has the prevalence of invalidating musculoskeletal pain changed over the last 15 years (1993-2006)? A Spanish population-based survey. J. Pain 11, 612–620. https://doi.org/10.1016/j.jpain.2009.09.015.

Kahraman, T., Genc, A., Göz, E., 2016. The Nordic Musculoskeletal Questionnaire: cross-cultural adaptation into Turkish assessing its psychometric properties. Disabil. Rehabil. 38, 1–8. https://doi.org/10.3109/09638288.2015.1114034.

Krokstad, S., Langhammer, A., Hveem, K., Holmen, T.L., Midthjell, K., Stene, T.R., Bratberg, G., Heggland, J., Holmen, J., 2013. Cohort profile: the HUNT study, Norway. Int. J. Epidemiol. 42, 968–977. https://doi.org/10.1093/ije/dys095.

Kuorinka, L., Jonson, B., Kilbom, A., Viterberg, H., Biering-Sorensen, F., Andersson, G., Jorgensen, K., 1987. Standardised Nordic questionnaires for the analyisis of muskuloskeletal symptoms. Appl. Ergon. 18 (3), 233–237. https://doi.org/10.1016/0003-6870(87)90010-x.

Legault, E., Cantin, V., Descarreaux, M., 2014. Assessment of musculoskeletal symptoms and their impacts in the adolescent population: adaptation and validation of a questionnaire. BMC Pediatr. 14, 173. https://doi.org/10.1186/1471-2431-14-173.

Lindell, L., Bergman, S., Petersson, I.F., Jacobsson, L.T., Herrström, P., 2000. Prevalence of fibromyalgia and chronic widespread pain. Scand. J. Prim. Health Care 18, 149–153. https://doi.org/10.1080/028134300453340.

López-Aragón, L., López-Liria, R., Callejón-Ferre, A.J., Gómez-Galán, M., 2017. Applications of the standarized nordic questionnaire: a review. Sustainability 9, 1514. https://doi.org/10.3390/su9091514.

McBeth, J., Nicholl, B.I., Cordingley, L., Davies, K.A., Macfarlane, G.J., 2010. Chronic widespread pain predicts physical inactivity: results from the prospective EPIFUND study. Eur. J. Pain 14, 972–979. https://doi.org/10.1016/j.ejpain.2010.03.005.

Memari, A., Shariat, A., Anastasio, A.T., 2020. Rising incidence of musculoskeletal discomfort in the wake of the COVID-19 crisis. Work 66 (4), 751–753. https://doi.org/10.3233/WOR-203221.

Namnik, N., Negahban, H., Salehi, R., Shafizadeh, R., Tabib, M.S., 2016. Validity and reliability of Persian version of the Specific Nordic questionnaire in Iranian industrial workers. Work 54 (1), 35–41. https://doi.org/10.3233/WOR-162268.

Palmer, K., Smith, G., Kellingray, S., Cooper, C., 1999. Repeatability and validity of an upper limb and neck discomfort questionnaire: the utility of the Standardized Nordic Questionnaire. Occup. Med. 49, 171–175. https://doi.org/10.1093/occmed/49.3.171.

Pugh, J.D., Gelder, L., Williams, A.M., Twigg, D.E., Wilkinson, A.M., Blazevich, A.J., 2015. Validity and reliability of an online extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E2) to measure nurses' fitness. J. Clin. Nurs. 24 (23–24), 3550–3563. https://doi.org/10.1111/jocn.12971.

Punamäki, R.L., Wallenius, M., Nygård, C.H., Saarni, L., Rimpelä, A., 2007. Use of information and communication technology (ICT) and perceived health in adolescence: the role of sleeping habits and waking-time tiredness. J. Adolesc. 30, 569–585. https://doi.org/10.1016/j.adolescence.2006.07.004.

Sirnes, E., Sødal, E., Nurk, E., Tell, G.S., 2003. Occurrence of musculoskeletal complaints in Hordaland. Tidsskr. Nor. Laegeforen. 123, 2855–2859.

Sjøgren, P., Ekholm, O., Peuckmann, V., Grønbaek, M., 2009. Epidemiology of chronic pain in Denmark: an update. Eur. J. Pain 13, 287–292. https://doi.org/10.1016/j.ejpain.2008.04.007.

Svebak, S., Hagen, K., Zwart, J.A., 2006. One-year prevalence of chronic musculoskeletal pain in an adult Norwegian county population. Relation with age and gender. The HUNT study. J. Musk. Pain 14, 21–28. https://doi.org/10.1300/J094v14n01_04.

Uhlig, B.L., Hagen, K., Engstrøm, M., Stjern, M., Gravdal, G.B., Sand, T., 2019. The relationship between obstructive sleep apnea and insomnia: a population-based cross-sectional polysomnographic study. Sleep Med. 54, 126–133. https://doi.org/10.1016/j.sleep.2018.10.026.

Wijnhoven, H.A., de Vet, H.C., Picavet, H.S., 2006. Prevalence of musculoskeletal disorders is systematically higher in women than in men. Clin. J. Pain 22, 717–724. https://doi.org/10.1097/01.ajp.0000210912.95664.53.

Wolfe, F., Smythe, H.A., Yunus, M.B., Bennett, R.M., Bombardier, C., Goldenberg, D.L., Tugwell, P., Campbell, S.M., Abeles, M., Clark, P., et al., 1990. The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Report of the multicenter criteria committee. Arthritis Rheum. 33, 160–172. https://doi.org/10.1002/art.1780330203.

Wolfe, F., Ross, K., Anderson, J., Russell, I.J., Hebert, L., 1995. The prevalence and characteristics of fibromyalgia in the general population. Arthritis Rheum. 38, 19–28. https://doi.org/10.1002/art.1780380104.

Wolfe, F., Clauw, D.J., Fitzcharles, M.A., Goldenberg, D.L., Hauser, W., Katz, R.L., Mease, P.J., Russell, A.S., Russell, I.J., Walitt, B., 2016. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. Semin. Arthritis Rheum. 46, 319–329. https://doi.org/10.1016/j.semarthrit.2016.08.012.

Woolf, A.D., Erwin, J., March, L., 2012. The need to address the burden of musculoskeletal conditions. Best Pract. Res. Clin. Rheumatol. 26, 183–224. https://doi.org/10.1016/j.berh.2012.03.005.

Yazici, Y., Gibofsky, A., 1999. A diagnostic approach to musculoskeletal pain. Clin. Cornerstone 2 (2), 1–10. https://doi.org/10.1016/s1098-3597(99)90010-8.

Yona, T., Weisman, A., Ingel, R., Masharawi, Y., 2020. The cross-cultural adaptation and reliability of the online Hebrew version of the extended Nordic Musculoskeletal Questionnaire. Musculoskelet Sci Pract 50, 102252. https://doi.org/10.1016/j.msksp.2020.102252, 2020.