Use of Physical Therapy in Patients With Osteoarthritis in Germany: An Analysis of a Linkage of Claims and Survey Data

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Objective. To examine the utilization of physical therapy (PT) and predictors for its use in individuals with osteoarthritis (OA) while focusing on sociodemographic and disease-related factors.

Methods. For this cross-sectional study, 657,807 patients (age 30–79 years) diagnosed with hip, knee, or polyarticular OA were identified in claims data. In 2016, a questionnaire including information on disease status, demography, and socioeconomics was sent to a random sample of 8,995 patients stratified by sex, age, and type of diagnosis. Claims data from 2016 included the utilization and type of PT, as well as the prescribing medical specialist, and were linked to questionnaire data. Multivariable logistic regression was conducted to determine variables associated with the use of PT.

Results. In total, 3,564 (40%) patients completed the questionnaire and agreed to linking questionnaire and claims data (69% female, mean age 66.5 years). In 2016, 50% of the study population received PT at least once, and women received it more frequently than men (53% versus 43%). Most PT was prescribed by orthopedists (45%) and general practitioners (32%). Multivariable logistic regression showed that women, higher household income, having both hip and knee OA, lower functional status, higher disease activity, and individuals living in the eastern, southern, and western states of Germany were associated with an increased utilization of PT.

Conclusion. Considering current guideline recommendations and that more than one-third of OA patients with high functional impairment and/or pain did not receive PT in the last 12 months, there is considerable potential for improvement. This is especially true for men and individuals with a low income.

INTRODUCTION

Osteoarthritis (OA) is the most common joint disorder and a leading cause of disability in older adults (1,2). Worldwide prevalence in individuals age >60 years is estimated at 10% in men and 18% in women (3). Overweight individuals are more frequently affected by OA (4,5). Because of both demographic changes and increasing populations with obesity in high-income countries, an increasing number of patients with this syndrome is to be expected (6).

OA is characterized by progressive, degenerative changes in the joints associated with pain, restriction in movement, and as a result, a diminished quality of life (7,8). As a consequence, primary goals in OA therapy are pain reduction and long-term preservation of joint function. Guidelines of OA management recommend education/self-management, analgesic and antiinflammatory medication, and low-impact behaviors (e.g., weight reduction if overweight or obese) as nonsurgical treatments (9–13). Furthermore, physical therapy (PT) is seen as one of the key elements of OA management (6,14). Exercise therapy as one of the main interventions in PT is particularly helpful in decreasing pain and preserving joint motion, for which high-quality evidence has been available for the past decade (15–18).

Data on the utilization of PT in patients with OA are scarce and vary across studies, and the populations included

Supported by the Federal Ministry of Education and Research within the PROCLAIR research network (grant 01EC1405).

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No potential conflicts of interest relevant to this article were reported.

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Submitted for publication February 3, 2020; accepted in revised form June 23, 2020.
are diverse. Carter et al reported outpatient PT use in 7% of patients with musculoskeletal conditions, but only 2% of them had OA (19). In a large Taiwanese cohort of 25,000 incident OA patients, 25% received PT 12 months after diagnosis (20). In a Canadian cohort of adults with at least moderately severe hip or knee OA, 19% received PT within the past year; of those, 65% had total joint replacement (TJR) surgery in the past year, and only 17% did not have TJR (21). Iversen et al reported the use of PT in 52% of patients with symptomatic knee OA, but these data refer to self-reports from patients enrolled in an exercise trial (22). In Germany, claims data showed the use of PT in 49% of patients with knee or hip OA 1 year before TJR (23).

Factors associated with the utilization of PT in patients with OA have been evaluated in a few studies. Most previous studies show that women receive PT more frequently than men (20–24), whereas Carter et al observed no differences (19). Being of younger age was another factor reported with a higher utilization of PT (25). Other studies showed no association between younger age and PT but less frequent utilization in the elderly (>65 years) (19,20) or no correlation at all (22,23). Higher income or education were associated with higher utilization of PT (19,20,22). However, results are inconsistent (19–26). Other important clinical and patient-reported factors such as functional status, comorbidities, and body mass index (BMI) have not been examined sufficiently. Taken together, most studies on the utilization of PT in OA include selected populations, and knowledge on the factors associated with its use is limited.

Therefore, this study aimed to evaluate the utilization of PT in a more representative sample of patients with OA as well as to identify factors associated with higher utilization by taking advantage of the linkage of claims data and self-reported patient outcomes.
South: Baden-Wuerttemberg, Bavaria; West: Hesse, North Rhine-Westphalia, Rhineland-Palatinate, Saarland) were retrieved.

Survey data. The questionnaire included information on sociodemographic characteristics such as household income and size of town. To evaluate functional status, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was used. This consists of 24 questions with 3 subscales, and it reports the components of pain, stiffness, and joint functionality as a total score (range 0–100, 100 representing the worst outcome) (31). Because individuals might have >1 symptomatic joint, they were instructed to answer based on the most severely affected joint. Additionally, BMI (obtained from height and weight) was requested, and disease activity was determined by the number and location (0–29) of chronically painful joints (i.e., continuous pain for at least 3 months in the last 2 years). Psychological well-being/presence of depressive symptoms was assessed using the WHO-5 Well-Being Index (WHO-5) (32). Scores were transformed (range 0–100) and categorized as moderate-to-severe (0–28), mild (29–50), and no (>50) depressive symptoms, an approach that has been validated in previous studies (32–34).

Statistical analyses. Because we used stratified sampling, the total number of individuals returning questionnaires who gave their consent for linking questionnaire data to claims data was weighted according to sex, type of diagnosis, and age group distribution of the total OA population (n = 657,807) in the claims data for all analyses. Characteristics of the study population were analyzed descriptively (percentages and SEM) and stratified by sex. The SEM was used instead of the SD due to the stratified nature of the study sample. The proportions of PT utilized were calculated with a 95% confidence interval (95% CI) and stratified by sex, residential area, and sociodemographic and disease-related factors. The proportions of prescribing medical specialists were analyzed with a 95% CI as well as the mean number of prescriptions and PT treatments. Univariable logistic regression analysis was used to determine the main demographic (age, sex, residential area, size of town), disease-related (WOMAC score, number of chronically painful joints, type of diagnosis, comorbidities, psychological well-being [WHO5-score], lifestyle factor (BMI), and socioeconomic (household income) characteristics that are associated with the utilization of PT. Finally, all variables were included in a multivariable model. Odds ratios were calculated with a 95% CI.

Figure 1. Flow chart of the study population. ICD-10-GM = International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, German version.
Cl. Nonoverlapping 95% CIs were considered statistically significant. For univariable and multivariable logistic regression, missing values for the WOMAC score, number of painful joints, WHO-5 score, household income, BMI, and size of town were imputed with multiple imputations (n = 10 imputations) (PROC MI) using the fully conditional specification method, assuming that data were missing at random. Data analyses were performed with SAS Enterprise Guide, version 9.4, using complex survey designs (SURVEYMEANS, SURVEYFREQ, and SURVEYLOGISTIC) that incorporated the stratified design into the analyses.

RESULTS

Response. A total of 8,995 individuals received the questionnaire. Of those, 3,775 (42%) responded, and after excluding invalid questionnaires and those who did not give their consent for linking questionnaire data to claims data, a total of 3,564 individuals were included in the analyses (Figure 1).

Individuals who responded were slightly older than those who had not responded (67.2 years versus 65.8 years), and the proportion of women was slightly higher (71% versus 69%).

### Table 1. Characteristics of the study population*

| Characteristic                          | Women (n = 1,952, 69.4%) | Men (n = 1,612, 30.6%) | Total (n = 3,564) |
|----------------------------------------|---------------------------|------------------------|-------------------|
| Age, mean ± SEM years (n = 3,564)      | 66.8 ± 0.08               | 65.9 ± 0.08            | 66.5 ± 0.06       |
| Diagnosis (n = 3,564)                  |                           |                        |                   |
| Knee OA                                | 48.3 (45.5–51.2)          | 52.2 (49.3–55.1)       | 49.5 (47.4–51.7)  |
| Hip OA                                 | 21.9 (19.6–24.1)          | 28.9 (26.2–31.5)       | 24.0 (22.2–25.8)  |
| Polyarticular OA                       | 16.3 (14.4–18.1)          | 7.3 (6.4–8.3)          | 13.5 (12.1–14.9)  |
| Hip and knee OA                        | 13.5 (11.6–15.5)          | 11.6 (9.7–13.5)        | 12.9 (11.5–14.4)  |
| Medical consultation (n = 3,564)†      |                           |                        |                   |
| General practitioner                   | 97.9 (97.2–98.6)          | 98.0 (97.2–98.7)       | 97.9 (97.4–98.4)  |
| Orthopedist                            | 65.3 (62.6–68.0)          | 59.8 (57.0–62.7)       | 63.6 (61.6–65.7)  |
| Rheumatologist                         | 8.1 (6.6–9.5)             | 4.4 (3.3–5.5)          | 7.0 (5.9–8.0)     |
| Other                                  | 96.4 (95.4–97.4)          | 95.8 (94.8–96.9)       | 96.2 (95.5–97.0)  |
| Household income, € (n = 3,313)        |                           |                        |                   |
| <1,500                                 | 35.0 (32.2–37.8)          | 23.0 (20.4–25.5)       | 31.3 (29.2–33.4)  |
| 1,500–3,200                            | 54.0 (51.1–56.9)          | 63.0 (60.1–65.9)       | 56.8 (54.6–59.0)  |
| >3,200                                 | 11.0 (9.4–12.6)           | 14.0 (12.0–16.0)       | 11.9 (10.6–13.2)  |
| WOMAC score, mean ± SEM (n = 2,879)    | 39.6 ± 0.69               | 36.7 ± 0.70            | 38.7 ± 0.52       |
| No. of painful joints (n = 3,417)      |                           |                        |                   |
| 0                                      | 24.3 (21.7–26.8)          | 26.9 (24.3–29.6)       | 25.1 (23.1–27.0)  |
| 1–4                                    | 40.9 (38.1–43.7)          | 48.7 (45.7–51.7)       | 43.8 (41.1–45.5)  |
| >4                                     | 34.8 (32.1–37.5)          | 24.4 (21.9–26.9)       | 31.6 (29.6–33.7)  |
| Depressive symptoms (WHO-5) (n = 3,334)|                           |                        |                   |
| No                                     | 52.6 (49.6–55.5)          | 57.3 (54.3–60.3)       | 54.0 (51.8–56.2)  |
| Mild                                   | 23.6 (21.1–26.1)          | 19.7 (17.3–22.0)       | 22.4 (20.5–24.3)  |
| Moderate to severe                     | 23.8 (21.4–26.3)          | 23.0 (20.5–25.5)       | 23.6 (21.7–25.4)  |
| BMI, mean ± SEM (n = 3,473)            | 28.4 ± 0.16               | 28.5 ± 0.13            | 28.4 ± 0.11       |
| Elixhauser comorbidity index score (ref. 30) (n = 3,564) |                        |                        |                   |
| 0–1                                    | 22.3 (20.1–24.6)          | 24.5 (22.1–26.9)       | 23.0 (21.3–24.7)  |
| 2–4                                    | 49.9 (47.1–52.7)          | 44.9 (42.0–47.8)       | 48.4 (46.2–50.5)  |
| 5–7                                    | 21.8 (19.4–24.2)          | 22.6 (20.2–25.1)       | 22.1 (20.2–23.9)  |
| >7                                     | 6.0 (4.5–7.4)             | 8.0 (6.3–9.6)          | 6.6 (5.5–7.7)     |
| Residential area (n = 3,563)‡          |                           |                        |                   |
| North                                  | 14.7 (12.7–16.7)          | 13.1 (11.1–15.0)       | 14.2 (12.7–15.7)  |
| East                                   | 30.3 (27.6–32.9)          | 28.8 (26.1–31.5)       | 29.8 (27.8–31.8)  |
| South                                  | 19.3 (17.1–21.6)          | 21.7 (19.3–24.1)       | 20.1 (18.3–21.8)  |
| West                                   | 35.7 (33.6–39.2)          | 36.4 (33.6–39.2)       | 35.9 (33.9–37.9)  |
| Population of town (n = 3,451)         |                           |                        |                   |
| <5,000                                 | 25.0 (22.5–27.4)          | 30.6 (28.0–33.3)       | 26.7 (24.9–28.6)  |
| <20,000                                | 25.4 (22.9–27.8)          | 26.3 (23.7–28.9)       | 25.6 (23.8–27.5)  |
| <100,000                               | 25.0 (22.4–27.5)          | 22.0 (19.5–24.4)       | 24.0 (22.1–25.9)  |
| <500,000                               | 12.9 (10.9–14.9)          | 10.5 (8.7–12.3)        | 12.1 (10.7–13.6)  |
| ≥500,000                               | 11.8 (10.0–13.7)          | 10.6 (8.8–12.4)        | 11.4 (10.0–12.9)  |

* Values are the percentage (95% confidence interval) unless indicated otherwise. Numbers are not weighted, percentages are weighted. BMI = body mass index; OA = osteoarthritis; WHO-5 = WHO-5 Well-Being Index; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index (Q1 = score ≤22.8; Q2 = score 22.9–39.5; Q3 = score 39.6–55.0; Q4 = score >55.0).
† Medical consultation: at least 1 consultation in 2016.
‡ North: Bremen, Hamburg, Lower Saxony, Schleswig-Holstein; East: Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, Thuringia; South: Baden-Wuerttemberg, Bavaria; West: Hesse, North Rhine-Westphalia, Rhineland-Palatinate, Saarland.
Prescription of opioids (15% versus 14%) and number of comorbidities according to the Elixhauser comorbidity index (median 2.5 versus 2.7) were comparable. There were larger differences in the prescription of nonsteroidal antiinflammatory drugs (48% versus 37%) and outpatient orthopedic care (58% versus 45%).

Characteristics of the study population. Table 1 gives an overview of the patients’ main sociodemographic and disease-related characteristics stratified by sex. A total of 69% were female, and the mean age was 66.5 years. Overall, 31% had a household income ≤€1,500. In 2016, 98% of the patients were treated at least once by a general practitioner (96% by other specialists, 64% by orthopedists, and 7% by rheumatologists). The mean WOMAC score was 38.7. In total, 25% had no, 44% had 1–4, and 32% had ≥5 chronically painful joints in the last 2 years. A total of 22% had mild signs of depression, and 24% had moderate-to-severe signs of depression according to the WHO-5. The proportion of women with a household income ≤€1,500 was higher than that of men (35% versus 23%). Women were more often diagnosed with polyarticular OA (16% versus 7%), and men were more frequently affected by hip OA (29% versus 22%).

Frequency of prescriptions for PT. Overall, 50% of the study population received PT at least once in 2016. Therapeutic exercise was the type of PT prescribed most commonly (36%), followed by manual therapy (16%) and thermotherapy (13%) (see Supplementary Tables 1 and 2, available on the Arthritis Care & Research website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24365/abstract). The mean number of prescriptions accounted for was 3.9 (95% CI 3.7–4.1), and the mean number of PT treatments was 24.8 (95% CI 23.2–26.3). Regarding prescribing medical specialist, most PT was prescribed to orthopedists (45%; 32% by general practitioners, 20% by other medical specialists, and 3% by rheumatologists).

Women received PT more frequently than men (54% versus 43%) (Table 2). This pattern was observed in every type of PT (see Supplementary Table 1, available at http://onlinelibrary.wiley.com/doi/10.1002/acr.24365/abstract). The proportion of patients with PT increased by age, from 43% in the age group 30–39 years to 53% in patients 70–79 years, with the exception of those 60–69 years of age (46%). Patients living in the eastern (59%) or southern (52%) states of Germany received PT more frequently than those living in the northern (48%) or western (42%) states. Manual therapy and thermotherapy were prescribed much more frequently in the eastern states of Germany, but therapeutic exercise was prescribed to a lesser extent than in the other states (see Supplementary Table 2, available at http://onlinelibrary.wiley.com/doi/10.1002/acr.24365/abstract). No differences were observed in size of town.

The utilization of PT increased in patients with a higher WOMAC score, high numbers of painful joints, comorbidities, and depressive symptoms (Figure 2 and Supplementary Table 3, available on the Arthritis Care & Research website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24365/abstract). The proportion of patients who had PT was smallest in those with a WOMAC score ≤22.8 (37%) and highest in those with a WOMAC score >55.0 (63%). PT was also prescribed more frequently if the knee and hip were affected by OA.

Univariable and multivariable logistic regression: predictors for utilization of PT. Univariable logistic regression models showed that female sex, hip and knee affection, higher WOMAC score, number of chronically painful joints, depressive symptoms, ≥5 comorbidities, and living in north, east, or south Germany were associated with higher PT utilization, whereas age, household income, BMI, and town size had no influence (Table 3). Multivariable logistic regression analysis revealed that female sex, having hip or knee OA, a higher WOMAC score, an increasing number of painful joints, and residential area were associated with receiving PT to a higher extent. Furthermore, patients with a household income ≤€1,500 were associated with less frequent utilization of PT. The number of comorbidities and psychological well-being did not remain statistically significant in the multivariable model, and age and BMI still had no influence on the frequency of utilization of PT.

DISCUSSION

The linkage of claims data with patient-reported outcomes enabled us to assess the impact of disease-related and
socioeconomic parameters on the utilization of PT in a large and heterogeneous population of individuals with OA. In 2016, 50% of the study population received PT at least once. In addition to higher utilization in women and individuals with high household income, more frequent utilization with higher disease burden was observed both in terms of the extent of pain and functional impairment and of the number of joints affected. Nevertheless, one-third of patients with high disease severity did not receive PT in the last 12 months.

Compared to previous studies, our results on the utilization of PT were high (19–21,35). For example, in a Taiwanese cohort, Yeh et al observed that 25% of incident OA patients received PT 12 months after their diagnosis (20). Less utilization may be explained by the fact that disease burden and disease activity in incident cases is lower. This corresponds to findings from a Canadian cohort of patients with at least moderately severe hip or knee OA, in which only 17% of adults without TJR but 65% of those with TJR received PT in the past year (21). In Germany, claims data from the same statutory health insurance fund as in the current study revealed comparably high PT utilization as the frequency identified here (49%) but in patients with knee or hip OA 1 year before TJR (23). In the US, comparably high utilization of PT as seen in the current study was observed in a population of patients with OA or rheumatoid arthritis by Hagglund et al (including occupational therapy) (39%) (36) and by Iversen et al (52%) (22), although the latter included study participants recruited for a clinical trial of exercise to manage symptomatic knee OA, which potentially led to a greater preference for PT in managing knee symptoms.

Utilization of PT in patients with OA has been associated with a variety of factors. For example, most previous studies have shown that men receive PT significantly less than women (20,22,23,25,35). We also observed a higher utilization of PT in women, confirming these findings. On the one hand, a plausible explanation may be that the time-consuming nature of PT is a critical barrier for patients, especially for men, who tend to prefer fast pain relief interventions such as drug treatment or surgery (37). Furthermore, Yeh et al speculated that men were less flexible in scheduling PT appointments because they worked more hours than women (20). On the other hand, women prefer holistic approaches (38) and are less inclined to receive invasive treatments (39). In addition, Hawker et al estimated that the potential need for arthroplasty was more than twice as great among women than among men (37), which also suggests that women are more receptive of conservative treatments like PT.

Age is another parameter that is discussed as an influencing factor for the utilization of PT. Rommel et al observed a higher utilization with increasing age for all residents in Germany age 18–79 years (35). Other studies showed no association between younger age and PT but less utilization in the elderly (>65 years) (19,20,40,41), which is surprising because function decreases
with increasing age, which would suggest a greater need for PT. A possible explanation is that low mobility or functional limitations of older adults may represent a hurdle for reaching the PT practice. Consequently, older adults’ preference for treatment may shift away from PT. However, there are also several studies showing no association at all between age and the utilization of PT (22,23,42). The results of the current study also showed no clear association between age and the utilization of PT.

Patients affected by both hip and knee OA had a significantly higher rate of PT utilization. It is likely that patients having both diagnoses are affected more with regard to pain and functional outcomes. This corresponds to our finding of a clear and statistically significant association between patient-reported limitation of functional status and the utilization of PT, confirming the results of previous studies of patients with musculoskeletal conditions (19,21,22,43,44). Both higher disease status (WOMAC score) and higher disease activity (number and location of chronically painful joints) were associated with greater utilization of PT. However, this also means that more than one-third of those with highly functional limitations and/or with >4 chronically painful joints did not receive PT in the last 12 months. For those patients, it might not be possible to receive PT continuously for years, but no contact at all with a physical therapist within 1 year might reduce the chances of pain relief, better joint function, and therefore improved quality of life (15,18).

Level of education and income are proxy measures for socioeconomic status (SES). To avoid collinearity, we selected household income to represent SES, and therefore, education was omitted from the model. While some studies provide evidence for an impact of education on the utilization of PT in the general population and in patients with musculoskeletal conditions or OA (19,22,36,40), few data are available on income (22). In

### Table 3. Factors associated with a higher utilization of physical therapy: results from univariable and multivariable logistic regression analyses (n = 3,564)*

| Characteristic                     | Reference | Odds ratio (95% confidence interval) |
|------------------------------------|-----------|--------------------------------------|
|                                    |           | Univariable analysis                 | Multivariable analysis |
| Sex                                |           |                                      |                          |
| Women                              | Men       | 1.50 (1.29–1.68)†                    | 1.47 (1.23–1.75)†       |
| Age                                | Per 10 years | 1.05 (0.99–1.13)                     | 1.05 (0.96–1.15)        |
| Diagnosis                          |           |                                      |                          |
| Hip and knee OA                    | Hip OA    | 1.59 (1.26–2.02)†                    | 1.50 (1.09–2.07)†       |
| Knee OA                            | Hip OA    | 1.01 (0.86–1.18)                     | 1.03 (0.82–1.28)        |
| Polyarticular OA                   | Hip OA    | 0.88 (0.73–1.06)                     | 0.87 (0.66–1.15)        |
| Household income, €                |           |                                      |                          |
| 1,500–3,200                        | €1,500    | 1.06 (0.87–1.29)                     | 1.21 (0.98–1.50)        |
| >3,200                             | €1,500    | 1.11 (0.85–1.46)                     | 1.53 (1.13–2.07)†       |
| WOMAC score                        | Per 10 units | 1.17 (1.12–1.23)†                   | 1.11 (1.05–1.18)†       |
| No. of painful joints              |           |                                      |                          |
| 1–4                                | None      | 2.08 (1.66–2.62)†                    | 2.85 (1.44–2.37)†       |
| >4                                 | None      | 2.88 (2.26–3.67)†                    | 2.21 (1.68–2.91)†       |
| Depressive symptoms (WHO-5)        |           |                                      |                          |
| Mild                               | No        | 1.24 (1.99–1.55)†                    | 1.00 (0.78–1.28)        |
| Moderate to severe                 | No        | 1.68 (1.35–2.09)†                    | 1.20 (0.92–1.57)        |
| BMI                                | Per 10 units | 1.11 (0.94–1.30)†                   | 0.91 (0.76–1.10)        |
| Elixhauser comorbidity index score (ref. 30) |           |                                      |                          |
| 2–4                                | 0–1       | 1.15 (0.98–1.34)                     | 1.1 (0.87–1.38)         |
| 5–7                                | 0–1       | 1.32 (1.98–1.60)†                    | 1.24 (0.92–1.67)        |
| >7                                 | 0–1       | 1.78 (1.29–2.44)†                    | 1.24 (0.80–1.91)        |
| Residential area‡                  |           |                                      |                          |
| North                              | West      | 1.56 (1.27–1.91)†                    | 1.38 (1.04–1.85)†       |
| East                               | West      | 2.10 (1.78–2.47)†                    | 1.95 (1.55–2.46)†       |
| South                              | West      | 1.55 (1.30–1.85)†                    | 1.57 (1.22–2.02)†       |
| Population of town                 |           |                                      |                          |
| <20,000                            | <5,000    | 0.86 (0.67–1.09)                     | 0.85 (0.66–1.08)        |
| <100,000                           | <5,000    | 0.78 (0.91–1.00)                     | 0.84 (0.65–1.09)        |
| <500,000                           | <5,000    | 1.07 (0.79–1.45)                     | 1.09 (0.79–1.50)        |
| >500,000                           | <5,000    | 1.26 (0.92–1.71)                     | 1.12 (0.82–1.54)        |

* Missing values imputed from 3% in body mass index (BMI) to 19% in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). OA = osteoarthritis; WHO-5 = WHO-5 Well-Being Index.† Odds ratios of variables significantly associated with the utilization of physical therapy.‡ North: Bremen, Hamburg, Lower Saxony, Schleswig-Holstein; East: Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, Thuringia; South: Baden-Wuerttemberg, Bavaria; West: Hesse, North Rhine-Westphalia, Rhineland-Palatinate, Saarland.
the multivariate analysis of the current study, household income <€1,500 was negatively associated with PT utilization compared to an income of >€3,200 per month, although in the univariate analysis, the association was not significant. In the high-income group, WOMAC scores were lower, and depression was present less often. Both lower WOMAC scores and less depression are associated with low levels of PT utilization, which explains this finding. In a comparable analysis, an association between household income and PT utilization was not found in individuals with rheumatoid arthritis (42). A possible explanation might be the smaller proportion of women and the older study population in the current study.

A few studies have investigated the influence of the size of town on the utilization of PT (20,40). For example, in community-based individuals ≥65 years of age, Freburger et al observed no differences in the utilization of PT in patients living in a rural or metropolitan area, but those living in a metropolitan area had a greater number of PT visits (40). Carter et al reported a pattern with a positive association from residing in an urban area for patients with musculoskeletal conditions (19). We found no variations in the size of town in which patients resided, but we observed regional differences in PT utilization. Especially in the eastern states of Germany, PT seems to play an essential role in the care of patients with musculoskeletal conditions. These regional variations were also found for PT utilization in the general population, both in questionnaire data (35) and claims data (45), as well as for specific diagnoses (23,25). Furthermore, results from the current study show that manual therapy and thermotherapy in particular are more frequently prescribed in East Germany, while exercise therapy is prescribed less often.

The main strength of the current study is the linkage of claims data from a nationwide statutory health insurance fund to questionnaire data from patients with OA. Utilization of PT, the prescribing medical specialist, and residential area are validly coded in claims data. Questionnaire data provided valuable additional information on disease-related, psychological, and lifestyle factors. Consequently, we were able to link the utilization of PT to patient-reported information such as pain and functional status, which, as far as we know, has not been done before. Some limitations have to be considered as well, mainly relating to the data used. The representativeness of the data needs to be discussed, as there are differences in the sociodemographic characteristics between several funds (46). Compared to the general population, individuals insured with Barmer were slightly older (mean age 53.7 years versus 52.4 years) and less often male (39% versus 47%), but there was no difference regarding higher education (28% versus 29%) (47). This might, to some extent, have led to differences in PT utilization. In addition, we were not able to determine whether a prescription of PT was related to the OA diagnosis coded in claims data or whether it was due to some other indication, which could have led to a higher utilization of PT. However, PT utilization in the German general population is lower (35); thus, a large proportion of PT visits should be due to OA. Moreover, medical specialists could have recommended other types of exercise (e.g., muscle strengthening in a gym), which were not available in claims data. Furthermore, individuals may have received PT in prior years and had already established an individualized program for themselves independently, or they may have worked with another type of health care practitioner. However, when evaluating the utilization of PT in the 2 years before the survey, 53% and 51% of the study population received PT at least once in 2014 and 2015, which is the same as in 2016. Utilization regarding sex, age, and residential region was also comparable to that in 2016, which suggests that this limitation did not hamper our findings. Another limitation is that the patients who responded are not completely representative of the whole sample. It is possible that the responders on average had a higher disease burden or greater dissatisfaction with their health care, which could have led to an overestimation of PT utilization for the general population of individuals with hip, knee, or polyarticular OA. However, we were able to compare characteristics of responders and non-responders using claims data. Finally, the data did not contain additional information on other potential influencing factors, such as provider characteristics (e.g., sex of the medical specialist and distance to the physical therapist), access to health care (e.g., copayment and transportation costs), or the perceived need for PT (19,20,22,40,48).

In conclusion, compared to the findings of previous studies, the utilization of PT by individuals with OA in the current study was high. Nevertheless, considering current OA management guidelines, which recommend PT as a first-line approach to conservative OA management, a higher utilization of PT is desirable. Clinicians and patients can be encouraged to utilize PT more often, especially male patients, individuals with a low household income, and patients with a high disease burden and functional limitations.

**AUTHOR CONTRIBUTIONS**

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Mr. Jacobs had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study conception and design.** Jacobs, Callhoff, Albrecht, Postler, Lange, Goronzy, Günther, Hoffmann.

**Acquisition of data.** Jacobs, Callhoff, Saam, Hoffmann.

**Analysis and interpretation of data.** Jacobs, Callhoff, Hoffmann.

**ADDITIONAL DISCLOSURES**

Author Saam is an employee of Barmer.

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