Effectiveness and costs of specialised physiotherapy given via ParkinsonNet: a retrospective analysis of medical claims data

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Summary
Background Parkinson’s disease is a complex condition that is best managed by specialised professionals. Trials show that specialised allied health interventions are cost-effective, as compared with usual care. We aimed to study the long-term benefits of specialised physiotherapy using the ParkinsonNet approach in real-world practice.

Methods We did an observational study, retrospectively analysing a database of health insurance claims that included a representative population of Dutch patients with Parkinson’s disease, who were followed for up to 3 years (Jan 1, 2013, to Dec 31, 2015). Eligibility criteria included having both a diagnosis of Parkinson’s disease and having received physiotherapy for the disease. Allocation to specialised or usual care physiotherapy was based on the choices of patients and referring physicians. We used a mixed-effects model to compare health-care use and outcomes between patients treated by specialised or usual care physiotherapists. The primary outcome was the percentage of patients with a Parkinson’s disease-related complication (ie, visit or admission to hospital because of fracture, other orthopaedic injuries, or pneumonia) adjusted for baseline variables. We compared physiotherapist caseload, the number of physiotherapy sessions, physiotherapy costs, and total health-care costs (including hospital care, but excluding community care, long-term care, and informal care) between the groups, and used a Cox’s proportional hazard model for survival time to establish whether mortality was influenced by treatment by a specialised physiotherapist.

Findings We analysed 2129 patients (4649 observations) receiving specialised physiotherapy and 2252 patients (5353 observations) receiving usual care physiotherapy. Significantly fewer patients treated by a specialised physiotherapist had a Parkinson’s disease-related complication (n=368 [17%]) than patients treated by a usual care physiotherapist (n=480 [21%]; odds ratio 0.67, 95% CI 0.56–0.81, p<0.0001). The annual caseload of patients per therapist was significantly higher for specialised physiotherapists (mean 3.89 patients per therapist [SD 3.91]) than usual care physiotherapists (1.48 [1.24]). Patients who saw specialised physiotherapists received fewer treatment sessions (mean 33.72 [SD 26.70]) than usual care physiotherapists (47.97 [32.11]). Consequently, expenditure was lower for specialised than usual care physiotherapists, both for direct costs (mean €933 [SD 843] vs €1329 [1021]; annual difference €395, 95% CI 358–432, p=0.0001) and total health-care expenditure (€2056 [3272] vs €2586 [3756]; €530, 391–669, p<0.0001). Mortality risk was lower for patients receiving specialised physiotherapy (134 [6%]) compared with patients receiving usual care physiotherapy (205 [9%]; p=0.001) before correction for baseline variables, although Cox’s survival model showed no significant difference between the two (hazard ratio 0.86, 95% CI 0.69–1.07, p=0.195).

Interpretation These results confirm the findings from controlled trials, and offer evidence that specialised physiotherapy as delivered through ParkinsonNet is associated with fewer Parkinson’s disease-related complications and lower costs in real-world practice. Neurologists can facilitate specialised physiotherapy by specific referral to such experts.

Funding None.

Background Parkinson’s disease is a progressive neurodegenerative disorder with a complex presentation, including a wide range of motor and non-motor features. Medical management, including pharmacotherapy and deep brain stimulation, offers only partial symptomatic relief. Although support is mounting for non-pharmacological interventions, including allied health treatments such as physiotherapy, occupational therapy, and speech-language therapy, allied health professionals are often without the specific expertise to treat patients with Parkinson’s disease. One way to achieve specialised care delivery is through the ParkinsonNet approach, which was developed in the Netherlands. ParkinsonNet offers an innovative model of care, in which allied health interventions are delivered within integrated regional community networks that consist of specifically trained therapists who work according to evidence-based guidelines and accumulate additional expertise by managing a high caseload of patients with Parkinson’s disease.

Several studies have evaluated the cost-effectiveness of specialised allied health interventions delivered within ParkinsonNet networks; this evidence is summarised in a recent review. The first study to assess the ParkinsonNet
Evidence before this study
We searched PubMed from the date of inception until Sept 30, 2017, using the following search terms: “Parkinson’s disease”, “physiotherapy”, and “ParkinsonNet”. The search was not restricted by language. ParkinsonNet is an innovative health-care approach, consisting of integrated multidisciplinary networks of allied health therapists specialised in treating patients with Parkinson’s disease. Although clinical trials show that ParkinsonNet is cost-effective, resulting in better quality of care, better outcomes, and lower health-care costs as compared with usual care, the long-term benefits in real-world clinical practice have not been studied.

Added value of this study
We evaluated the effects of specialised ParkinsonNet physiotherapy using a large medical claims database (4381 unique patients with Parkinson’s disease) with follow-up of up to 3 years. Our results indicate that specialised physiotherapy is associated with better quality of care (higher caseload of patients with Parkinson’s disease per physiotherapist, better continuity of care, and fewer treatment sessions), lower costs (both physiotherapy and total health-care costs), and better outcomes (fewer hospital visits for Parkinson’s disease-related complications—ie, visit or admission to hospital because of fracture, other orthopaedic injuries, or pneumonia) than usual care physiotherapy.

Implications of all the available evidence
Our findings are in line with those of randomised trials, and show that specialised physiotherapy is associated with fewer Parkinson’s disease-related complications and lower costs than usual care, in daily clinical practice; therefore, it would be reasonable for specialised interventions like ParkinsonNet to become usual care.

Research in context

Methods
Study design
We did an observational study that consisted of a retrospective, economic evaluation (using a health-care perspective), based on longitudinal claims data from a large Dutch health insurer (CZ Groep) with a market share of 21% (ie, 21% of all Dutch citizens are insured with CZ Groep). We did not do a complete cost-effectiveness analysis (eg, including an incremental cost-effectiveness ratio) because our database does not contain the specific information on patient-related outcomes needed for this analysis. The claims database contains the diagnostic and treatment data for a representative population of patients with Parkinson’s disease, who were treated in everyday practice for up to 3 years. In 2014, around 23% of the overall Dutch population with Parkinson’s disease was covered by CZ Groep, which is comparable to this insurer’s overall market share and suggests that the included patients were comparable to those covered by other insurers in the Netherlands. During the study period, neither CZ Groep nor any other Dutch health insurer applied selective contracting, so the generalisability of the findings will not have been affected by financial incentives to stimulate use of ParkinsonNet therapy. The claims database contained 7599 unique patients allocated a diagnosis-related cost group (DRG) for Parkinson’s disease, collected over a 3-year period (Jan 1, 2013, to
Dec 31, 2015), with 15,149 annual observations (each patient offers one annual observation for each entire year during which they are included in the database).

ParkinsonNet is one example of how specialised physiotherapy can be delivered. We refer to the group of patients who received ParkinsonNet physiotherapy as having received specialised physiotherapy. We evaluated the effect of one allied health discipline (specialised physiotherapy) because physiotherapy is by far the most commonly prescribed allied health intervention for Parkinson’s disease. Eligibility criteria included having both a DRG for Parkinson’s disease and having received treatment by any physiotherapist (specialised or usual care) for Parkinson’s disease during at least one of the three observation years (2013–15). These broad eligibility criteria allowed for inclusion of a large and representative population, irrespective of age, sex, or comorbidity. Patients were included in our analyses in the year they first received physiotherapy, and remained in the analyses for the remainder of the observation period, regardless of whether or not they received additional physiotherapy in the ensuing years. Patients were eligible for inclusion regardless of whether or not they had received physiotherapy for Parkinson’s disease in the years prior to the observation period.

We compared two patient groups based on the type of physiotherapy received: either specialised physiotherapy (ie, with a physiotherapist trained in Parkinson’s disease as part of ParkinsonNet) or usual care (ie, with a physiotherapist not trained in Parkinson’s disease as part of ParkinsonNet). Both types of physiotherapy include sessions of around 30 min (this being the standard duration for a physiotherapy session in a community practice in the Netherlands). Importantly, both referring physicians and patients are free to choose their own allied health professional in the Netherlands (mostly based on proximity). This situation offers a unique real-world opportunity to compare specialised physiotherapy as part of ParkinsonNet to usual care physiotherapy. Patients were allocated to the specialised care group if they had received more than 75% of their physiotherapy sessions from a ParkinsonNet physiotherapist. All other patients were allocated to the usual care group.

This study was done in accordance with the Declaration of Helsinki and article 23 of the Dutch personal protection act (section 23.2). No ethical approval or informed consent was obtained because of the observational, retrospective nature of the study. As part of the standard health insurance policy, all patients included in the claims database had agreed to their data being used anonymously for analyses.

**Procedures and statistical analysis**

We did four types of prespecified analysis to compare outcomes and expenditures between groups. We studied the number of Parkinson’s disease-related complications as our primary outcome. Specifically, we examined the probability of sustaining a Parkinson’s disease-related complication over the 2013–15 period, using a regression model with type of treatment (specialised care vs usual care) as an independent factor, and a set of individual characteristics as covariates. Our database is unbalanced because 11% (n=443) of patients were not included during the entire 3-year study period, with reasons for attrition including patient death, patient switch to another health insurer (hence claims data became unavailable), and entry of new patients into the database. Because we analysed annual outcome data, patients had one, two, or three

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**Figure: Study profile**

*Patients were included if they had a diagnosis code for Parkinson’s disease in the database of the health insurer, CZ Groep, and received physiotherapy for Parkinson’s disease. †Patients who died during the study period were excluded from the analyses in the following year or years. ‡Patients who changed health insurance provider were excluded from the analyses the following year or years. §Patients who were either newly enrolled in the database or newly received physiotherapy. ||180 patients died.
repeated outcomes. To accommodate for this attrition, we used a generalised mixed-effects model to account for the correlations between repeated outcomes.

We defined a Parkinson’s disease-related complication as having a hospital visit or admission because of one or more of the following events: sustaining a fracture, sustaining other orthopaedic injuries, or pneumonia. To correct for confounding factors and differences in baseline characteristics, we included age, sex, socioeconomic status, and proxies for health status as independent variables. The baseline characteristics and proxies for health status vary every year, and these were all integrated in the model to accommodate potential differences in health status. The claims database did not include any specific measures of Parkinson’s disease severity or comorbidity; therefore, we operationally defined Parkinson’s disease-related health status as: number of neurologist visits, with higher numbers suggesting greater disease severity; number of Parkinson’s disease-specific drugs per patient, with higher numbers suggesting greater disease severity; whether or not patients were taking antidepressants, with depression being a marker for greater disease severity; whether or not patients received mental health care, with the need for care suggestive of cognitive problems and greater disease severity; and, number of different health-care professionals involved in each patient’s management, with higher numbers suggestive of greater disease severity.

To explain possible differences in outcomes, we examined the nature of the two types of physiotherapy. Specifically, we compared the number of physiotherapy sessions between patients treated by either a specialised physiotherapist or a usual care physiotherapist. We also studied the continuity of care, by analysing the number of physiotherapy sessions that were delivered by the same therapist for each patient throughout the observation year, and by examining how many patients received care from more than one physiotherapist throughout the observation year.

In addition, we examined whether mortality was influenced by treatment by a specialised physiotherapist using a Cox’s proportional hazard model for survival time. Finally, we did a post-hoc analysis to evaluate whether mortality was associated with Parkinson’s disease-related complications (unrelated to Parkinson’s disease) could explain any observed group differences. For this purpose, we used pharmaceutical costs groups based on the 2012 medical claims data of the CZ Groep for all included patients (more recent data were unavailable at the time of study). The pharmaceutical costs groups data show whether patients use any medication for one (or more) of 24 different diagnoses unrelated to Parkinson’s disease (eg, cancer, asthma, and diabetes).

### Table 1: Baseline characteristics for patients with Parkinson’s disease who received either specialised or usual care physiotherapy

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specialised physiotherapy (n=2129)</th>
<th>Usual care physiotherapy (n=2252)</th>
<th>Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>72.76 (9.14)</td>
<td>73.61 (9.39)</td>
<td>0.85 (0.30 to 1.39)</td>
</tr>
<tr>
<td>Women</td>
<td>863 (41%)</td>
<td>994 (44%)</td>
<td>3.60% (0.67 to 6.53)</td>
</tr>
<tr>
<td>Socioeconomic status*</td>
<td>0.14 (0.98)</td>
<td>0.22 (1.07)</td>
<td>0.08 (0.01 to 0.14)</td>
</tr>
<tr>
<td>Neurology outpatient visits</td>
<td>1.77 (0.86)</td>
<td>1.68 (0.85)</td>
<td>-0.09 (-0.14 to -0.04)</td>
</tr>
<tr>
<td>Depression</td>
<td>466 (18%)</td>
<td>373 (21%)</td>
<td>3.20% (0.84 to 5.50)</td>
</tr>
<tr>
<td>Professional disciplines consulted†</td>
<td>0.69 (0.79)</td>
<td>0.76 (0.83)</td>
<td>0.07 (0.02 to 0.11)</td>
</tr>
<tr>
<td>Different Parkinson’s disease drugs†</td>
<td>1.67 (0.92)</td>
<td>1.80 (0.99)</td>
<td>0.13 (0.08 to 0.19)</td>
</tr>
<tr>
<td>Use of mental health care</td>
<td>181 (9%)</td>
<td>253 (11%)</td>
<td>2.74% (0.96 to 4.50)</td>
</tr>
<tr>
<td>Years included in the study</td>
<td>2.18 (0.84)</td>
<td>2.38 (0.73)</td>
<td>0.22 (0.17 to 0.27)</td>
</tr>
</tbody>
</table>

Data are mean (SD), n (%), or difference (95% CI). The differences between groups were significant at p<0.05 for each characteristic, and therefore all variables in this table were used for adjustment of subsequent analyses. *Scale from 0.00 to 6.00, with lower numbers indicating a lower socioeconomic status. †Scale from 0.00 to 4.00. ‡Scale from 0.00 to 6.00.

### Role of the funding source

There was no funding source for this study. All authors had full access to all data and the corresponding author had final responsibility for the decision to submit for publication.

### Results

58% of patients (4381 of 7599 unique patients) received physiotherapy during the study period (10002 annual observations; figure). All patients had received hospital care by a neurologist, and had one or more episodes of physiotherapy care. 2129 (49%) patients were treated by a specialised physiotherapist (4649 observations), and 2252 (51%) by a usual care physiotherapist (5353 observations). Baseline characteristics and proxies for health status were largely similar for both groups, although several small differences were significant because of our large sample size (table 1). These baseline characteristics...
characteristics were therefore included in all subsequent statistical analyses as covariates.

The length of the observation period was similar for both groups (mean 2·18 years for specialised physiotherapy [SD 0·84], mean 2·38 years for usual care physiotherapy [0·79]), which was also reflected by the proportion of patients with 3 years (995 [44%] vs 1287 [56%]), 2 years (530 [50%] vs 527 [50%]), and 1 year (604 [58%] vs 438 [42%]) of follow-up.

The probability of sustaining a Parkinson’s disease-related complication was lower for patients receiving specialised physiotherapy (n=368, 17%) than patients receiving usual care physiotherapy (n=480, 21%), and this difference was significant (uncorrected odds ratio 0·76, 95% CI 0·63–0·90, p=0·002; after adjustment for baseline variables odds ratio 0·67, 0·56–0·81, p=0·0001).

Annually, specialised physiotherapists treated more patients with Parkinson’s disease than usual care physiotherapists (p<0·0001; table 2). Because we have data from only one health insurer, the actual number of patients with Parkinson’s disease treated per physiotherapist is expected to be larger. Patients who saw specialised physiotherapists also received fewer physiotherapy sessions per patient per year than did patients who saw usual care therapists (mean 33·72 [SD 26·70] vs 47·97 [32·11], p<0·0001; table 2), which was associated with lower annual expenditure for physiotherapy for patients receiving specialised care than those receiving usual care (mean difference €395, 95% CI 358–432, p=0·0001). Total annual medical expenses, including hospital expenditure, were also significantly lower for patients receiving specialised care (mean difference €530, 391–669, p=0·0001). This difference was not affected by correction for baseline characteristics and proxies for health status (tested with linear regression; see appendix). Furthermore, specialised care offered better continuity of care than usual care. For specialised care, 93% of visits over the study period were delivered by the same therapist, as opposed to 81% for usual care (p<0·0001). Raising the cutoff for allocation to specialised physiotherapy (ie, to values higher than 75% of patients being with a specialised physiotherapist) did not affect the results (results for different cutoff values are included in the appendix).

The mortality risk was lower for patients receiving specialised physiotherapy (134 [6%] of 2129 patients died) compared with patients receiving usual care physiotherapy (205 [9%] of 2252 patients). Although the absolute difference was significant (p=0·001; table 2),
after correction for baseline characteristics and health status, the difference was no longer significant (Cox’s survival model, hazard ratio 0.86, 95% CI 0.69–1.07; p=0.195; table 3).

Separate post-hoc analysis of the three components of the primary outcome showed significant benefits in favour of specialised physiotherapy for fractures, other orthopaedic injuries, and pneumonia (appendix). All proxies for Parkinson’s disease-related health status were, as expected, associated with more frequent disease complications (table 4). We have included the results of the full uncorrected analyses in the appendix. The post-hoc analysis of comorbidity unrelated to Parkinson’s disease showed that patients receiving specialised physiotherapy had a mean of 0.48 pharmaceutical costs groups (SD 0.69), and patients receiving usual care, 0.51 pharmaceutical costs groups (0.70; n=4224). This difference was neither significant nor clinically relevant.

**Discussion**

Our results confirm and extend the findings of earlier clinical trials, and show that, compared with usual care, specialised physiotherapy delivered via ParkinsonNet is associated with better outcomes—ie, fewer hospital visits or admissions because of a fracture, other orthopaedic injuries, or pneumonia. Specialised physiotherapists offer greater continuity of care (which is often something patients say they wish for), with greater efficiency (fewer treatment sessions) per patient, and at lower costs (lower direct treatment costs, and lower total health-care costs for Parkinson’s disease). Finally, specialised physiotherapy was associated with reduced mortality, although the difference was not significant after adjustment for baseline characteristics and health status. Although we should interpret the results of our study cautiously because of its observational nature, they suggest that specialised physiotherapy, in this case delivered according to the ParkinsonNet model, was successful in daily clinical practice, outside the controlled framework of clinical trials.

We evaluated established physiotherapists who had been working within specialised networks for several years, had accumulated a high caseload of patients with Parkinson’s disease, and thus had substantial practical experience with this patient group. In the present study, specialised physiotherapists treated significantly more patients with Parkinson’s disease than usual care physiotherapists. Therapists with more experience treating patients with Parkinson’s disease might achieve better outcomes than therapists who have just completed their specialised training. The expertise gained from daily clinical practice might explain the absence of improved health outcomes in the cluster-controlled trial as compared with the reduced number of Parkinson’s disease-specific complications in our study.

Considering health-care expenditure, our results suggest that both direct physiotherapy costs and total expenditure for Parkinson’s disease (including hospital care, but excluding community care, long-term care, and informal care) were lower for patients receiving specialised physiotherapy than patients receiving usual care physiotherapy. The overall cost savings associated with specialised over usual care physiotherapy (about €530 annually) can be explained by the greater efficiency of care (specialised therapists offered fewer treatment sessions, and consequently had lower direct treatment costs), and the improved outcomes (fewer admissions for Parkinson’s disease-related complications). Specialised therapists presumably required fewer sessions to reach their desired endpoint, after which no further sessions were needed (stopping the treatment after goals have been reached is a core part of the ParkinsonNet approach). Similar cost savings were observed previously, both in a 2010 cluster-controlled trial (annual cost savings of around €1400 per patient) and in a claims analysis by the consultancy firm KPMG (annual cost savings of €640 per patient per year in 2008; savings of €381 in 2009). Our findings offer converging evidence—along with findings from controlled trials—to suggest that specialised physiotherapy, as part of ParkinsonNet, is a cost-effective approach in daily practice.

Analysis of claims data offers a valuable addition to clinical trials on physiotherapy in Parkinson’s disease. Recent well-designed studies indicate that cueing strategies are effective to overcome episodes of freezing of gait, and that exercise can reduce both motor and non-motor symptoms of Parkinson’s disease. Many treatment modalities are available, and new approaches are emerging, such as fall prevention strategies, dance, aquatic therapy, dual task training, exergaming, and virtual reality training. However, negative outcomes have also been reported, but these results can probably be explained by differences in methods. For complex and personalised interventions like physiotherapy, the choice of an adequate primary outcome can be difficult, and the

### Table 4: Regression results of the random effects model to examine the effect of specialised physiotherapy on Parkinson’s disease-related complications

<table>
<thead>
<tr>
<th>Description</th>
<th>Odds ratio (SE)</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.95 (0.00)</td>
<td>0.94–0.95</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Sex</td>
<td>1.20 (0.11)</td>
<td>1.00–1.44</td>
<td>0.047</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>0.93 (0.04)</td>
<td>0.85–1.01</td>
<td>0.097</td>
</tr>
<tr>
<td>Diagnosis-related cost group for Parkinson’s disease</td>
<td>1.88 (0.09)</td>
<td>1.71–2.06</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Drugs related to Parkinson’s disease</td>
<td>1.14 (0.05)</td>
<td>1.04–1.24</td>
<td>0.004</td>
</tr>
<tr>
<td>Depression</td>
<td>1.15 (0.14)</td>
<td>0.91–1.45</td>
<td>0.230</td>
</tr>
<tr>
<td>Professional disciplines consulted</td>
<td>1.53 (0.08)</td>
<td>1.37–1.71</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Use of mental health care</td>
<td>1.28 (0.21)</td>
<td>0.92–1.76</td>
<td>0.140</td>
</tr>
<tr>
<td>Treated by specialised physiotherapist</td>
<td>0.67 (0.06)</td>
<td>0.56–0.81</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Patients were excluded from this analysis in the year they died (n=339).
The duration of follow-up was often short. The dose (treatment intensity) of physiotherapy might also be an influencing factor, and this varied considerably across studies. In our study, patients receiving specialised physiotherapy received, on average, 34 sessions (SD=27) that typically lasted 30 min, suggesting total session time of 1020 min. One might argue that this high intensity of treatment explained the positive outcomes; however, this dose is in line with the European Physiotherapy Guideline for Parkinson’s disease, which recommends a minimum of three sessions per week, 45 min each, for 8 weeks (totaling 24 sessions, lasting 1080 min). Additionally, this guideline indicates that longer treatment times are probably needed to achieve sustained treatment effects. Indeed, in one negative study, the intervention consisted of a median of only four sessions; thus, these patients might have received an under-dosed treatment. These findings emphasise that, much like pharmacotherapy, dose-finding studies are an important step for physiotherapy and other allied health interventions. We realise that the treatment intensity of physiotherapy in the Netherlands might be high compared with that in other countries; therefore, our results (fewer treatments and better outcomes with specialised physiotherapy over usual care physiotherapy) cannot be extrapolated to international populations of patients with Parkinson’s disease unless a similar intensity of specialised physiotherapy is adopted in other countries. Final challenges in physiotherapy studies include potential selection and inclusion bias (most trials included a specific population that was not necessarily representative of the general population) and poor adherence to treatment. An analysis of claims data, as we did, has the advantage of a longitudinal analysis with long follow-up, within a large and unbiased sample of patients.

The observational nature of our study also brings about some limitations. We cannot eliminate the possibility of referral bias or a potential between-group difference in disease severity or comorbidity. For example, stimulated by publicly available information about the positive trial findings, the referring physicians might prefer to send their more complex patients to specialised care, and less severely affected patients to usual care. Although a difference in disease severity could then explain some of our results, our analyses suggest that baseline characteristics for patients receiving specialised care were largely similar to those of patients receiving usual care physiotherapy—at least for the baseline characteristics available to us (age, sex, and socioeconomic status), the differences were small and not clinically meaningful. The claims database contained no Parkinson’s disease-specific scales, which hampered our ability to control for differences in disease severity or duration. However, we used several reasonable proxies for (Parkinson’s disease-related) health status, including number of neurology outpatient visits, number of drugs for Parkinson’s disease, presence of depression, use of mental health care, and number of different health-care professionals consulted. These were all largely similar for patients in both groups, and the observed baseline group differences were small and presumably clinically irrelevant. Moreover, we accommodated these baseline differences in all statistical analyses. Finally, the pharmaceutical costs groups analysis identified no between-group differences, considering medication intake for a wide range of comorbidities unrelated to Parkinson’s disease. These results suggest that the observed differences between expert physiotherapy and usual care cannot be explained by major differences in patient characteristics.

Another possible source of referral bias could be that patients with higher levels of education might be more inclined to demand a dedicated referral to a specialised physiotherapist. However, in our study, socioeconomic status and proxies for (Parkinson’s disease-related) health status did not show large, clinically relevant differences between both groups; thus, this bias is unlikely. In the Netherlands, patients are referred to a physiotherapist, who is typically chosen on the basis of proximity, by their general practitioner or neurologist. Dutch health insurers do stimulate a dedicated referral to ParkinsonNet by disseminating information but, for the observation period described, there were no financial stimuli to preferentially refer patients to specialised physiotherapists. Moreover, during the study period, reimbursement of treatment was equal for ParkinsonNet care and usual care.

We should point out that Parkinson’s disease-related complications occurred in only a small number of patients, reducing the power of our analyses. The reduction was significant for the pooled result of several typical complications (ie, combination of fractures, other orthopaedic injuries, and pneumonia), but was also detectable for each of these three separate Parkinson’s disease-related complications. Moreover, our results corroborate findings from a survey by the consultancy firm KPMG, which also suggested (using a different approach) that patients receiving specialised ParkinsonNet care are less likely to sustain a hip fracture (an approximately 50% reduction was noted).

Finally, we cautiously interpret our finding of a tendency towards a lower mortality risk for patients receiving specialised physiotherapy. The absolute difference (3% reduction in favour of specialised physiotherapy) was significant, but this disappeared after correction for baseline characteristics and health status. Specialised physiotherapy does not primarily aim to prolong survival, but the combination of better care and fewer disease complications might, with time, result in fewer deaths as compared to both no therapy and usual care physiotherapy. Indeed, hip fractures and aspiration pneumonia are important causes of death for patients with Parkinson’s disease, and these appear partially preventable by administering specialised physiotherapy. Further work in larger groups followed up...
over longer time periods is needed to address this hypothesis.

Despite the limitations of database studies, our observations complement those of clinical trials because of the inclusion of a representative real-life population without attrition, the large sample size, and the long follow-up. Based on our results, we argue that patients with Parkinson’s disease should preferably be treated by expert physiotherapists. General neurologists might facilitate this by specific referral. Our findings might also have implications for Parkinson’s disease management guidelines and for the policies of organisations that pay for physiotherapy. We recommend that specialised interventions (like ParkinsonNet) should become usual care, and their use be promoted by inclusion in guidelines for management of Parkinson’s disease and by incentives for organisations that pay for Parkinson’s disease care.

**Contributors**

JHLY, LHHMb, and BRB developed the study concept. JHLY and LHHMb collected the data. JHLY, LHHMb, XK, and AHZ were responsible for statistical analyses. JHLY, NMdV, LHHMb, XK, and BRB drafted the manuscript. All authors were involved in interpretation of the data and reviewing the manuscript. All authors have approved the final version.

**Declaration of interests**

JHLY and LHHMb were employed at CZ Groep at the time of the study, but this study was done outside the employment of CZ Groep with their consent. NMdV reports a research grant of the Netherlands Organization for Health Research and Development. XK reports grants from the Ministry of Volksgezondheid Welzijn en Sport (Netherlands Department of Health), Centrum Inzichtdetectie, Zorg (Netherlands governmental body indicating long-term health care), Nederlandse Zorg autoriteit (national governmental care authority), Uitvoeringsinstituut Werknemers Verzekeringen (Netherlands national governmental body for social security), BENU, CZ Groep, Achmea, De Friesland, VGZ, Menzis, GlaxoSmithKline, and Esprit, and personal fees from the Netherlands governmental administrative body outside the submitted work. MM is the Managing Director of ParkinsonNet. BRB serves as Associate Editor for the Journal of Parkinson’s Disease, has received honoraria from serving on the scientific advisory board for Zambon, fees for speaking at conferences from AbbVie, Zambon, and Bial, and research support from the Netherlands Organization for Health Research and Development, the Michael J Fox Foundation, the Princes Beatrice Foundation, the Stichting Parkinson Fonds, the National Parkinson Foundation, and the Parkinson Vereniging. AHZ reports no competing interests.

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**References**


