

RESEARCH

# Impact of COVID-19 Pandemic on Perceived Access and Quality of Care in German People with Parkinson's Disease

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## Abstract

**Background:** Research on social determinants of health suggests that not all people with Parkinson's Disease (PD) have been equally impacted by the COVID-19 pandemic. Therefore, this study examines the influence of individual and structural determinants on the perceived health care situation during the Covid-19 pandemic in Germany.

**Methods:** Analyses rely on an anonymous survey carried out as part of the abbreviation iCARE PD missing (iCARE-PD)-project. Within the scope of the project, a 49-items questionnaire was developed which aimed at characterising the access of PD-patients to healthcare services prior and during the pandemic.

**Results:** 551 questionnaires were filled out from all over Germany. Satisfaction for PD-related care significantly decreased during the pandemic. Educational level, perceived expertise of healthcare providers, confidence in remote care, perceived ease of obtaining healthcare prior to the pandemic, the ability to access care prior to the pandemic, density of neurologists within the area of living and the ability to overcome barriers were indicative of higher odds to perceive unmet needs during the pandemic.

**Discussion:** The results of this study show that not only structural conditions determine people's access to healthcare and that people with poorer Social determinants of health (SDH) experience a greater feeling of not having received needed health services during the COVID-19 pandemic.

**Conclusion:** In order to learn from the pandemic in the long term, difficulties in access to healthcare must be uncovered and addressed. Further investigations into the effect of individual and structural influences on measures of healthcare experiences during the COVID-19 pandemic in the German PD-population are needed.

**Keywords:** Parkinson's disease; COVID-19 pandemic; health care; impact; influence; Germany; iCARE-PD

## Background

The COVID-19 pandemic has presented modern societies with unprecedented challenges. The uncontrolled spread of a virus that causes potentially fatal side effects despite intensive care and the resulting necessity to reduce everyday life has afflicted societies economically and culturally. However, the impact on healthcare systems has been particularly drastic. With rising incidences, public life around the world came to a standstill and access to public services, including health care, was reduced to the bare minimum. This standstill has affected individuals in societies differently

with vulnerable groups, such as people with chronic illnesses, being particularly affected by the restrictions [?, ?, ?]. This is not overly surprising in that chronic illnesses negatively affect individual psychosocial functioning [?] often leaving affected patients in need of social, financial or physical support. People with chronic diseases are primarily dependent on ongoing medical services outside of emergencies and therefore appeared to be at high risk of undersupply during the pandemic.

The group of the chronically ill also includes people with Parkinson's Disease (PD). PD-patients show a progressive condition characterized by motor but also non-motor symptoms. A plethora of different clinical signs may emerge during the disease's course, which is why continuous therapy adjustments and need assessments by healthcare professionals are required. Recent studies have unveiled the impact of the COVID-19 pandemic on people suffering from PD [?, 1, 2, 3, ?]. What remains unclear, however, is whether all patients were equally affected by the COVID-19 restrictions.

Studies from other areas of public health research indicate very individual affection for public health crisis [4, 5]. With regard to PD-patients, individual care needs may dictate the degree of affection during the pandemic [2]. More generally, so-called Social determinants of health (SDH) may also condition the individual affection [6]. SDH are non-medical factors that influence, among other things, peoples' access to healthcare and may have effects on both individual and societal levels [7]. Well investigated SDH are, for example, income, gender or coverage for health expenses [8, 9]. The association between SDH and individuals' access to health was evident not least during the COVID-19 pandemic, such that some populations experienced greater impacts than others based on their SDH [10]. People with PD in particular are at the mercy of a good social support network, which raises the question of whether patients with poorer SDH were affected more severely by the COVID-19 crisis.

What may be considered relevant SDH is by no means universal. Rather, a context-specific consideration is required [7]. For PD, Zaman et al. proposed a model summarising structural and individual factors potentially influencing patients' access to healthcare [11]. Structural SDH may thereby be encompassed barriers, that PD-patients meet on a system-level when accessing healthcare, such as a lack of care coordination, limited communication between healthcare providers, disparities in health services or the unavailability of specialised services [11]. Personal and therefore individual barriers, influencing PD-patients' abilities to seek help or to engage with care providers, to reach important care services or to pay for them [11] may likewise be of great importance.

To our knowledge, it has not yet been investigated how SDH may relate to the COVID-19 pandemic on PD-patients' access to healthcare. Therefore, we examined the impact of a multitude of factors on this population with special emphasis on their access to healthcare during the pandemic in Germany.

## Methods

### Questionnaire

Analyses rely on an anonymous survey carried out as part of the iCARE-PD-project (<https://icare-pd.ca/>). Within the scope of this project, a 49-items questionnaire was developed which aimed at characterising the access of PD-patients to health-care services before and during the pandemic. The initial questions in English were translated to German and were structured in four sections: A) questions describing patients' health status (in terms of PD but also of concomitant diseases), B) questions regarding experiences with healthcare services within twelve months before the pandemic, C) questions addressing experiences with healthcare services during the COVID-19 pandemic with special emphasis on telemedicine services, and, D) questions devoted to ascertaining demographic backgrounds of participants. There were single, multiple-choice questions or open-ended questions, some of which depended upon the specific answers to previous ones. A full version of the questionnaire is included in the supplementary material.

The questionnaire was distributed nationwide using the members' e-mail newsletter of the German Parkinson Association (Deutsche Parkinson Vereinigung, DPV) between November 2020 to January 2021. The e-mail included a short invitation as well as a link to an online survey, which patients could access using a personal computer, a tablet or a smartphone. In Germany, SoSci Survey [?] served as a database for hosting the survey. Throughout the data input, the database was supervised and manually checked for plausibility. In addition to Germany, the iCARE-PD questionnaire was also shared with patient associations in Canada, Spain, Portugal and the Czech Republic with the respective translations. In this study, we limit ourselves to data collected from German patients.

### Additional data

Within the last section of the survey, participants were asked to disclose the first three of five numbers of their German postal code, which allowed for regional data containment. We concatenated resulting data with publicly available population densities<sup>[1]</sup> and those for family doctors and neurologists<sup>[2]</sup>. Merging the available data with the maps for postal codes<sup>[3]</sup> resulted in maps (cf. Figure 1). Densities were stratified into five equal quantiles for further analyses. Moreover, the provided information of concomitant diseases (besides PD) was collated to a score – the Elixhäuser Comorbidity Score with its modification introduced by van Walraven *et al.* [12]; here, higher values indicate more severe disease burden. Finally, all questions were assigned to barriers to accessing health services regarding PD as described by [11] (cf. Table ?? supplementary data).

### Statistical analyses

All analyses were conducted in R[13]. After estimation of descriptive statistics, satisfaction with overall PD-related care was compared before and during the pandemic

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<sup>[1]</sup>[https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/Raumabgrenzungen/deutschland/regionen/Raumordnungsregionen/raumordnungsregionen-2017.xlsx?\\_\\\_blob=publicationFile&v=3](https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/Raumabgrenzungen/deutschland/regionen/Raumordnungsregionen/raumordnungsregionen-2017.xlsx?_\_blob=publicationFile&v=3)

<sup>[2]</sup><https://gesundheitsdaten.kbv.de/cms/html/16402.php>

<sup>[3]</sup><https://www.suche-postleitzahl.org/downloads>

using a non-parametric *sign-test* (rstatix package, <https://github.com/kassambara/rstatix/>). The two questions that were used were:

- “In the 12 months prior to the COVID-19 pandemic, overall, how satisfied are you with the way healthcare services related to Parkinson’s Disease were provided?” (B17) vs.
- “Since the beginning of the COVID-19 pandemic, overall, how satisfied are you with the way healthcare services related to Parkinson’s Disease are provided?” (C6).

Furthermore, using a Generalised Linear Model (GLM) we estimated the odds for worse satisfaction with PD-related care. After establishing the full model with a total of 32 predictors, we conducted a stepwise logistic regression in order to reduce the complexity leaving the most meaningful predictors for the question: “Since the beginning of the COVID19 pandemic, how often did you feel you needed healthcare for Parkinson’s disease but did not receive it?” (C4). For that purpose, first missing data were imputed by taking advantage of a multivariate imputation scheme using the MICE-package [14]. We thereby assumed data missing at random and used the Predictive Mean Matching Method (PMM). After missing data imputation, stepwise reduction using a GLM with Stepwise Feature Selection (*glmStepAIC*) in both directions from the *caret*-package [15] aimed at minimising the Akaike Information Criterion (AIC). For that, we first split all data into 80% of training and 20 % of test data and performed the stepwise regression after centering and rescaling values and applying 10-fold cross-validation. The predictions of the two models were compared with the test data using Accuracy, Area Under The Curve (AUC) and LogLoss as metrics. All data for the analyses and all analyses can be followed under <https://github.com/dpedrosac/covidPD/>

## Results

In total, 552 questionnaires were filled out with 252 different postal codes from all 16 German regions (Bundesländer, cf. Figure 1A). Of all participants, 388 (70.4%) returned a complete questionnaire (for demographics from parts A and D, cf. Table 1).

Satisfaction for PD-related care significantly decreased during the pandemic. Hence, the *sign-test* for the question: “Overall, how satisfied are you with the way healthcare services related to Parkinson’s Disease are provided?” indicated lower values during the pandemic (Mdn = 1) compared to before (Mdn = 3,  $p = 10^{-73}$ ). More than 90% of all participants stating to be rather unsatisfied or very unsatisfied with their PD-related care during the pandemic (cf. Figure 2).

To ascertain underlying reasons for dramatic declines in satisfaction, logistic regressions on question C4 (“Since the beginning of the COVID-19 pandemic, how often did you feel you needed healthcare for Parkinson’s Disease but did not receive it?”) was performed unveiling different factors which contributed to this perception of unmet needs during the pandemic (cf. Figure 3). Thus odds to affirm this question were highly significant ( $p < .001$ ) for those patients inferring lower levels of competence for their neurologist, with a lower ability to access PD-care before the pandemic, for patients with higher degrees of stigmatisation in healthcare and for those who did not receive healthcare services before the pandemic. A significant contribution – albeit lower with significance values  $p < .05$  – was encountered for PD-patients with increasing levels of comorbidity, with perceived lower expertise of the General practitioner (GP), with higher quality of life scores retrospectively, for people with higher financial burden due to PD or who rescheduled healthcare due to financial burden before the pandemic. Finally, the lack of availability of remote healthcare during the pandemic and geographical or in general more numerous barriers in access to healthcare before the start of the pandemic were also indicative of higher odds to perceive unmet needs. For an illustration of significant predictors see Figure 3 and for the entire list of results cf. Table ?? in the supplementary material.

Starting with the entirety of 32 questions that might be predictors of affirming question “C4” (see above), using a two-way stepwise regression model these could be reduced to 7 which were: educational level, perceived expertise of the general practitioner, confidence in remote care, ease obtaining healthcare before the pandemic, ability to access care before the pandemic, the density of neurologists within the area of living and the ability to overcome barriers (cf. Table 2). Markers for model comparison were indicative of similar performances in the “full model” with 32 predictors compared to the reduced one (cf. Figure 4)

## Discussion

In this study, we sought to investigate factors contributing to insecurity and the feeling of not having received health services during the COVID-19 pandemic in Germany. To the best of our knowledge, this is the first time that SDH have been related to access to healthcare of German PD-patients during this extraordinary crisis. With our study, we demonstrate that not all patients were affected equally but that structural, as well as, individual determinants massively influence PD-patients' access to healthcare. Viewing the pandemic as the focal lens of an ongoing demographic change in Western societies, our findings may thus enable a deeper insight into factors that may be addressed to improve future care of PD-patients.

It remains undisputed that the COVID-19 pandemic has been the defining event in recent years. At a relatively early stage of the pandemic and before the availability of vaccination provided some relief, our data reflect people's unbiased and acute concerns regarding their own healthcare. Interestingly, a good overall performance has been attested to the German healthcare system during the pandemic, [16], which is transferable on healthcare data in persons with PD [2]. However, a good testimony for a healthcare system should not be equated with an adequate range of services, especially when it comes to very specific needs of chronically-ill and specifically PD-patients. In the recent literature, several aspects of inadequate care have been reported insinuating a rather partial insufficiency.

One of the major challenges specialised physicians face when treating PD is the diverse phenotypes the condition presents with. Multimodal therapeutic approaches have been put forward indicating great benefits for patients (Quelle??). Yet, increasing prescriptions of Multimodal Complex treatments has not been paralleled with parsimonious availability of these highly specialised services in all regions of Germany making sometimes long journeys necessary [17]. In a similar vein, an only slowly increasing offer regionally networked care approaches [18] and therefore a lack of specialised staff providing integrated health care services hinder access to specialists despite being advisable [19], not to mention the unresolved questions of financing concepts [20]. Our results underline these structural conditions determining people's access to healthcare but additionally outline individual aspects of SDH which determine a greater feeling of not having received needed health services during the COVID-19 pandemic. The overarching question of an efficient allocation of healthcare services for PD-patients could significantly determine our daily lives in a future world of growing demand and low supply.

Without anticipating the results of the surveys in other countries, various studies already suggest diverging physical and other obstacles our patients face everyday. Survey data from 9,762 participants including 5,429 persons with PD in the United States concluded that the personal background should not be disregarded when investigating individual satisfaction with healthcare. With respect to our data, it does not surprise that the disruption of daily activity during the pandemic was more common in single persons even more so if they had lower incomes.

Strikingly and in good accordance with the proposed concept of SDH, Brown *et al.* reported that subjects with less personal resources were less likely to report alternative means of exercise or social activities, but also that with diminishing resources with increasing age patients were less likely to use alternative ways to exercise [6].

One of the proposed remedies for people who are not within reach of healthcare services or who may not ask for assistance could be the training on social media use or the implementation of validated telehealth services.

Telehealth services have been shown to facilitate access to care for person's with PD [?, ?]. In this questionnaire, we could corroborate these results as those patients who already had access to these services reported a reduced likelihood of unmet care needs during the pandemic. Yet, it must be born in mind that this patient cohort must be deemed rather technology-savvy according to the nature of the questionnaire so that we agree that this process is not generalisable for all German patients [?]. Further investigations are warranted, e.g., on how to increase the confidence in telemedicine or how to overcome technological limitations such as high-speed internet availability. Another possible caveat to consider are putative unintended negative effects on health equity, so that PD-patients with low incomes or with other barriers to accessing technology could be left behind and thus underserved [?].

### General Limitations:

Despite revealing problems patients encountered during the COVID-19 pandemic, the interpretation of our results requires some caution. Hence, it was an anonymous online survey so that the representativeness for the German PD population is not warranted. As abovementioned, not only patients filling out the questionnaire may be highly selected from a major support group in Germany but especially the online tool also suggests that it is more likely to be filled out by tech-savvy patients. In this context, the mean age of almost 67 years was surprising, so that young-onset PD-patients cannot be inferred from this. Finally a limitation is also the fact that there was no way to control for misdiagnosis or the correctness of data, so that these results await confirmation in observational studies with more controlled demographics information.

### Conclusion

In order to learn from the pandemic in the long term, difficulties in access to healthcare must be uncovered and addressed. The results of this analysis showed that the COVID-19 pandemic did not affect all PD-patients equally, but that people who experienced individual and structural barriers to accessing healthcare before the pandemic were more affected during its course. Therefore, it is important to examine these determinants more closely and to address them in future-oriented, resilient healthcare models. Further investigations into the effect of individual and structural influences as by Zaman *et al.* defined on measures of healthcare experiences should be object of further scrutiny.

### Acknowledgements

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#### Abbreviations

AIC	Akaike Information Criterion	4
AUC	Area Under The Curve	4
DPV	Deutsche Parkinson Vereinigung	7
GLM	Generalised Linear Model	4
GP	General practitioner	5
iCARE-PD	abbreviation iCARE PD missing	1
PD	Parkinson's Disease	1
PMM	Predictive Mean Matching Method	4
SDH	Social determinants of health	1

#### Availability of data and materials

The iCARE-PD-project, which poses the umbrella for this study, was registered under DRKS00025764 in the German Clinical Trial Register ([https://www.drks.de/drks\\_web/navigate.do?navigationId=trial.HTML&TRIAL\\_ID=DRKS00025764](https://www.drks.de/drks_web/navigate.do?navigationId=trial.HTML&TRIAL_ID=DRKS00025764)). Data from all participants and all analyses are available under <https://github.com/dpedrosac/covidPD>

#### Ethics approval and consent to participate

The study was approved by the local Ethics committee (reference number: AZ 164/19) and carried out in accordance with the Declaration of Helsinki. All patients gave informed written consent prior to participating.

#### Competing interests

The authors declare that they have no competing interests.

#### Consent for publication

All authors have written and agreed the final version of the manuscript.

#### Authors' contributions

Conceptualization, D.P., M.vM.; methodology, D.P.; software, D.P.; formal analysis, D.P., M.vM., M.R.P.; provision of resources, D.P.; writing—original draft preparation, D.P., M.vM., M.R.P.; writing—review and editing, D.P., M.vM.; visualization, D.P.; supervision, D.P.. All authors have read and agreed to the published version of the manuscript.

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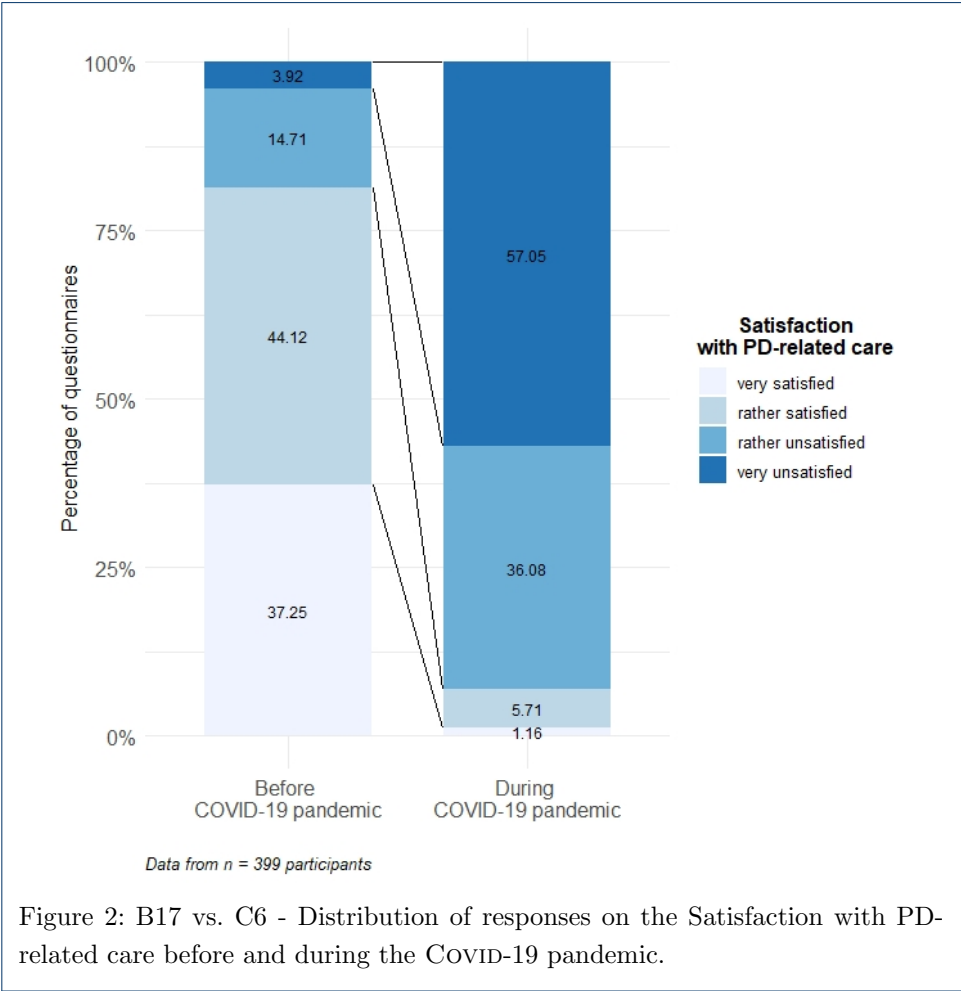
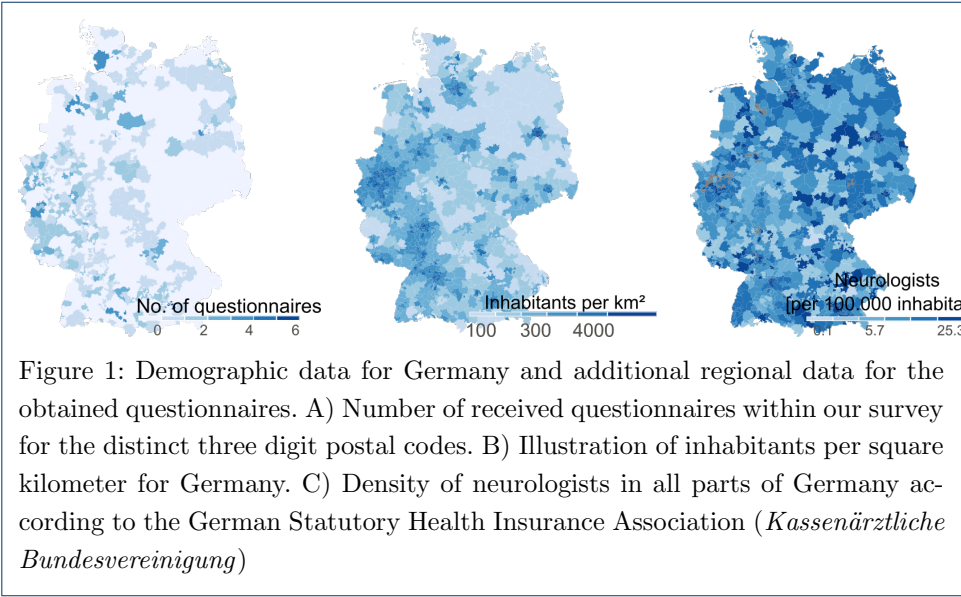
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Figures



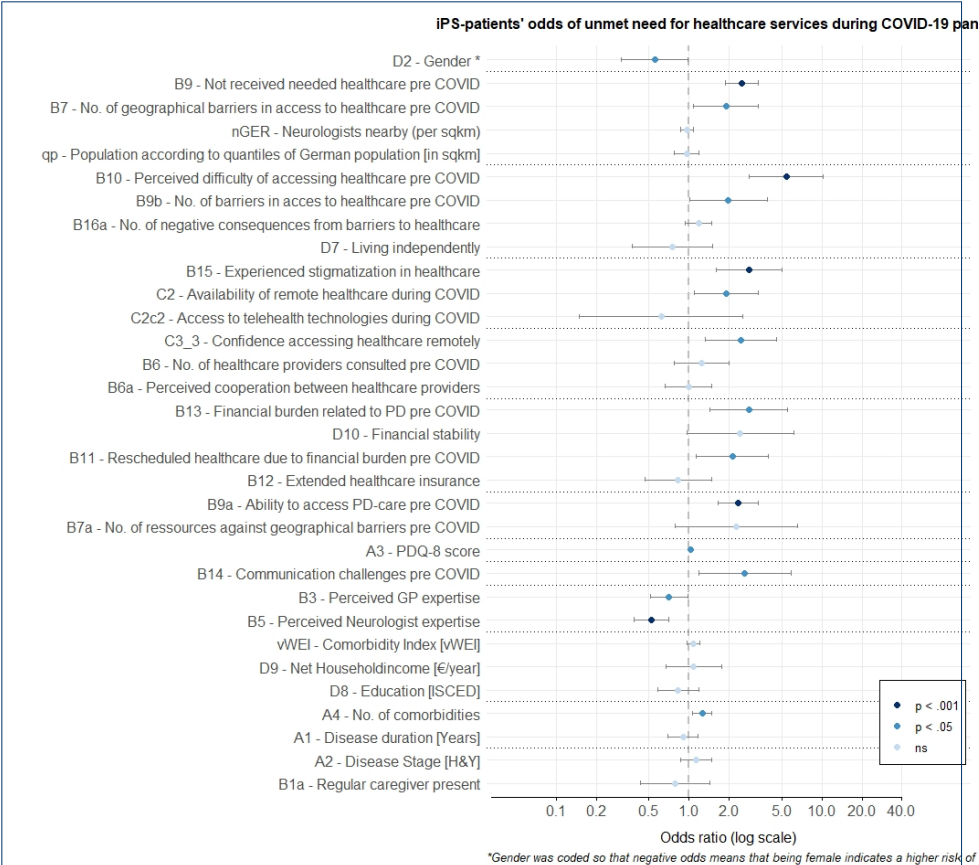


Figure 3: Unadjusted Odds ratios according to the GLM for all 32 questions. Odds were determined so that higher values indicate affirmation to the question that healthcare was needed but this need remained unmet during the COVID-19 pandemic. The dashed lines indicate the distinct domains according to Zaman et al. [11], whereas significance is illustrated as color of the dot, with two distinct levels of significance.

Tables  
Additional Files

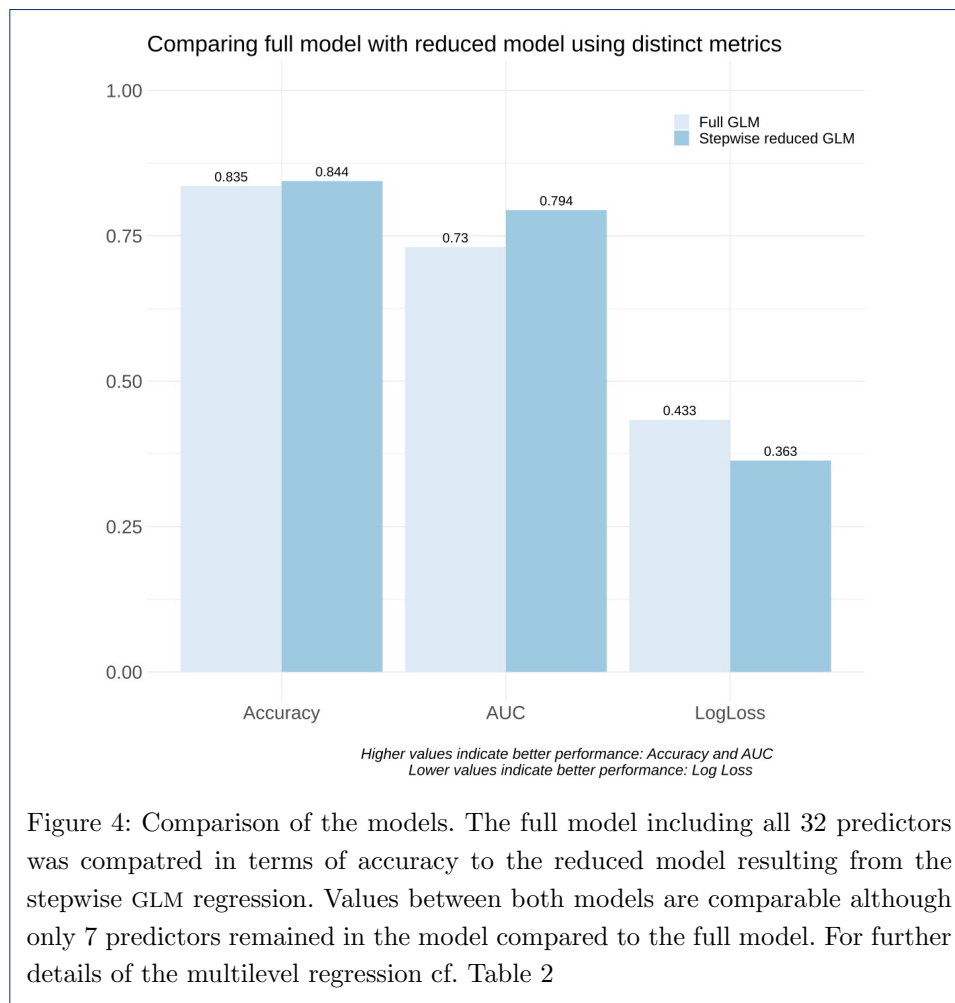


Table 1: Demographics of subjects filling out questionnaire:

	Overall (n = 552)
Age (mean (SD))	66.76 (9.25)
Gender = female (%)	148 (41.6)
Disease duration (%)	
<2 years	62 (13.1)
2–5 years	154 (32.6)
5–10 years	157 (33.2)
10–15 years	69 (14.6)
>15 years	31 ( 6.6)
Disease stage (%)	
Hoehn & Yahr I	189 (40.3)
Hoehn & Yahr II	156 (33.3)
Hoehn & Yahr III	77 (16.4)
Hoehn & Yahr IV	41 ( 8.7)
Hoehn & Yahr V	6 ( 1.3)
Education level according to ISCED (%)	
primary education	20 ( 5.0)
secondary education	234 (58.4)
post secondary education	69 (17.2)
highest education level possible	78 (19.5)
PDQ-8 scores (mean (SD))	41.30 (14.23)
Van-Walraven-Elixhauser Comorbidity Index (mean (SD))	6.55 (1.95)

Table 2: Significant factors contributing to unmet care needs during COVID-19 pandemic according to the reduced GLM:

Predictor	Estimate	Std.Error	zvalue	<i>p</i>
(Intercept)	-2.65	0.29	-9.24	<.0001
Educational level (D8)	-0.73	0.24	-3.01	0.003
Perceived GP's expertise (B3)	0.34	0.17	2.07	0.038
Confidence in accessing necessary services remotely (C3)	0.64	0.22	2.90	0.004
Ease obtaining healthcare prior to the pandemic (B10)	-0.47	0.22	-2.15	0.031
Ability to access care prior to the pandemic (B9)	0.41	0.20	2.07	0.038
Density of Neurologists	0.47	0.21	2.22	0.027
Overcoming barriers (B7a)	-0.51	0.22	-2.38	0.017

Table 3: Matching of items in the questionnaire to the categories from the work of Zaman et al. [11]

	Question from Covid-Survey	Representative for what barrierer
tab3:matchingzaman)	1. A2, B1	Autonomy
	2. A1, A4, vWEI	Health Status
	3. D8, D9	Health Literacy
	4. B3, B5	Health Belief
	5. B14a	Communication (personal)
	6. PDQ-sum score	Self-efficacy
	7. B7a, B9a/b	Transportation
	8. B11, B12, B13, D10	Cost of care
	9. NA	Difficulties of Diagnosis
	10. C3, B6a, B6	Coordination in care
	11. B15, B14, C2c	Communication (system)
	12. B16, B16c, D6, D7, B9b, B10	Disparity in Health Services
	13. B7, B8, B9,	Unavailability of Specialist Services
	14. D2	Other

Table 4: Odds ratios for the distinct items of the questionnaire  
tab4:resultsall)

Factors	Domain	Odds Ratio	CI lower	CI upper	p-value
A2 - Disease Stage [H&Y]	Autonomy	1.13	0.87	1.47	0.367
B1a - Regular caregiver present	Autonomy	0.79	0.43	1.44	0.438
A1 - Disease duration [Years]	Health Status	0.9	0.69	1.16	0.419
A4 - No. of comorbidities	Health Status	1.26	1.06	1.49	0.007
vWEI - Comorbidity Index [vWEI]	Health Belief	1.08	0.97	1.21	0.155
D8 - Education [ISCED]	Health Belief	0.82	0.58	1.18	0.284
D9 - Net Household income [per/year]	Health Belief	1.08	0.67	1.75	0.75
B3 - Perceived GP expertise	Health Literacy	0.71	0.51	0.98	0.038
B5 - Perceived Neurologist expertise	Health Literacy	0.52	0.39	0.7	p < .001
B14 - Communication challenges pre COVID	Communication (personal)	2.63	1.18	5.82	0.017
A3 - PDQ-8 score	Self-efficacy	1.03	1.01	1.05	0.011
B7a - No. of resources against geographical barriers pre COVID	Transportation	2.27	0.79	6.51	0.129
B9a - Ability to access PD-care pre COVID	Transportation	2.33	1.65	3.31	p < .001
B11 - Rescheduled healthcare due to financial burden pre COVID	Cost of care	2.11	1.13	3.93	0.019
B12 - Extended healthcare insurance	Cost of care	0.83	0.46	1.48	0.521
B13 - Financial burden related to PD pre COVID	Cost of care	2.81	1.42	5.53	0.003
D10 - Financial stability	Cost of care	2.43	0.97	6.09	0.059
C3.3 - Confidence accessing healthcare remotely	Difficulties of Diagnosis	2.44	1.32	4.53	0.005
B6a - Perceived cooperation between healthcare providers	Difficulties of Diagnosis	0.99	0.66	1.49	0.975
B6 - No. of healthcare providers consulted pre COVID	Difficulties of Diagnosis	1.24	0.77	1.99	0.374
B15 - Experienced stigmatization in healthcare	Coordination in care	2.84	1.6	5.03	p < .001
C2 - Availability of remote healthcare during COVID	Coordination in care	1.91	1.09	3.34	0.023
C2c2 - Access to telehealth technologies during COVID	Coordination in care	0.62	0.15	2.53	0.5
B16a - No. of negative consequences from barriers to healthcare	Communication (system)	1.18	0.93	1.48	0.166
D7 - Living independently	Communication (system)	0.75	0.38	1.51	0.421
B9b - No. of barriers in access to healthcare pre COVID	Communication (system)	1.98	1.01	3.89	0.048
B10 - Perceived difficulty of accessing healthcare pre COVID	Communication (system)	5.37	2.84	10.17	p < .001
B7 - No. of geographical barriers in access to healthcare pre COVID	Disparity in Health Services	1.9	1.08	3.33	0.026
Population according to quantiles of German population [in sqkm]	Disparity in Health Services	0.96	0.77	1.19	0.714
B9 - Not received needed healthcare pre COVID	Disparity in Health Services	2.5	1.88	3.32	p < .001
nGER - Neurologists nearby (per sqkm)	Disparity in Health Services	0.97	0.87	1.07	0.527
D2 - Gender *	Unavailability of Specialist Services	0.55	0.31	0.98	0.044