CHANGING NURSING CARE TIME AS AN EFFECT OF CHANGED CHARACTERISTICS OF THE DIALYSIS POPULATION

Ria de Kleijn [1], Carin Uyl-de Groot[2], Chris Hagen[3], Casper Franssen[1], Jeanette Schraa[4], Pieternel Pasker-de Jong[5], Piet ter Wee[6]
[1]Department of Nephrology, Universitair Medisch Centrum Groningen, University of Groningen, Groningen, The Netherlands
[2]Erasmus School of Health Policy & Management, Erasmus University, Rotterdam, The Netherlands
[3]Dialysecentrum Midden Nederland, Meander Medisch Centrum, Amersfoort, Harderwijk, The Netherlands
[4]Ziekenhuis St. Jansdal and Dialysecentrum Midden Nederland, Harderwijk, The Netherlands
[5]Meander Academie, Meander Medisch Centrum, Amersfoort, The Netherlands
[6]Amsterdam UMC, Vrije Universiteit Amsterdam, Zorgsupport and Nephrology, Amsterdam, The Netherlands

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SUMMARY

Background: The population of dialysis patients is ageing. Dialysis nurses are confronted with geriatric patients with multiple comorbidities. Nurses are confronted with an increasing burden of care.

Objectives: The present study focused on the question of whether, over time, the increasing age and comorbidities of the haemodialysis population increased nursing care time. Furthermore, we studied potential changes in the predictors of the required nursing time.

Design: Observational study.

Participants: A total of 980 dialysis patients from 12 dialysis centres were included.

Measurements: Nurses filled out the classification tool for each patient and completed a form for reporting patient characteristics for groups of relevant haemodialysis patients at baseline and after 1 and four years. Changes in patient and dialysis characteristics were analysed, as well as the estimated nursing care time needed.

Results: An increase in the nursing time needed for dialysis was largely due to decreased mobility, closing of the vascular access and a greater need for psychosocial attention and was most strongly present in incident dialysis patients. The time needed for dialysis decreased as patient participation increased and vascular access changed from catheters to fistulae. Over the four-year period, the average overall needed nursing care time per haemodialysis session did not change.

Conclusions: Our study shows that the average nursing time needed per patient did not change in the four-year observation period. However, more time is required for incident patients; thus, if a centre has high patient turnover, more nursing care time is needed.

KEY WORDS Burden of care • Elderly patient • Haemodialysis • Workload

BIODATA

Ria de Kleijn *is working as a project manager at the University Medical Centre Groningen, Department Nephrology. Before that, she was the manager of Kidney Centre Middle Netherlands for 12 years. She was trained as a nurse with specialisations Child Nursing and Neonatology. She has a first-degree teaching qualification for nursing. In 2006 she obtained a Master of Business Administration.*

CORRESPONDENCE
Ria de Kleijn,
Department of Nephrology,
Universitair Medisch Centrum Groningen,
University of Groningen,
Ubbegalaan 16, 9727 DT Groningen,
The Netherlands
Email: riadekleijn@home.nl

INTRODUCTION

The population of western societies is ageing, and this trend is associated with a rise in the number of patients with chronic diseases who increasingly have multiple comorbidities (Divo *et al.* 2014). Likewise, the age of dialysis patients worldwide is increasing, as is the number of disabilities they have (Cook *et al.* 2006).

In December 2016, there were 5,450 haemodialysis patients in the Netherlands, which has a total population of over 16.9 million people. Of these patients, 67.6% were over 65 years old, and within that group, 40.0% were older than 75 years. The absolute influx of patients into dialysis has been stable in recent years, but the influx of patients aged 75 years and older is increasing (Hoekstra *et al.* 2015).

In Belgium, the numbers are similar: 4,248 haemodialysis patients were counted in December 2016, of a total population of over 11.2 million people. Of these patients, 66.7% were over 65 years old (Belgian Society of Nephrology 2017). In this ageing population, the frequent underlying causes of end-stage renal disease are type 2 diabetes mellitus, hypertension and/or atherosclerotic vascular disease (De Grauw *et al.* 2009; De Jong *et al.* 2011).

In addition to the increasing age of dialysis patients, it is well-known that this patient population is characterised by the presence of multiple comorbidities. As the dialysis population is ageing and has an increasing number of comorbidities, dialysis nurses must increasingly treat elderly patients who may need more nursing care time. This potentially increases the burden of dialysis care for the individual patient and for the dialysis department, enhanced by a shortage of qualified nurses and increasing costs.

We previously developed and validated an instrument (De Kleijn *et al.* 2015) that can be used to measure the burden of nursing care for patients receiving haemodialysis. The instrument has been shown to be a good predictor of the time needed in various types of dialysis centres (De Kleijn *et al.* 2017).

LITERATURE REVIEW

Adequate staffing in a dialysis department is crucial to provide high-quality care (Wolfe 2011), a statement that is based on the classic framework of Donabedian (1966). Adequate staffing asks for alignment with the characteristics of the patient population that is being treated and should be flexible to adapt to changing patterns of the population. Although patient classification systems have been reported to improve the quality and efficiency of nursing care (De Kleijn *et al.* 2017) studies in the literature that describe a patient classification system for dialysis nurses are scarce (Kane *et al.* 2007).

Brady *et al.* (2007) argued that nursing care is labour-intensive and service-oriented and therefore difficult to measure. Conversely, Kane *et al.* (2007) concluded that better deployment of nurses results in better care results, especially in high-risk departments such as the dialysis unit. Aiken *et al.* (2011) also argued that a pleasant working environment, well-trained nurses and better staffing, benefit healthcare provision. Sloane *et al.* (2018) additionally concluded that improvements in the working environment of nurses and better deployment of staff increased the quality of care and patient safety.

Sutherland Boal and Silas (2015) developed an evidence-based, safe nurse staffing toolkit to determine the direct care time of nurses. These authors highlighted that safe staffing starts with knowing the needs of your patients, how these needs can be met and which components should be part of staff planning, for example, real-time assessment of patients' needs and workload measurements, multidisciplinary consultation, and adequate models for organising the delivery of optimal care by the right persons.

In the study 'Dialysis department 2.0.', the efficient deployment of nurses was investigated (Antonides and Ooms 2017; Ebrecht 2017). This study did not focus on the burden of care for the individual dialysis patient, but on planning of the staff and connecting the planning to the daily life of the HD patient.

During the past 20 years there has been a dramatic increase in elderly patients on dialysis and nowadays more than 50% of dialysis patients is older than 65 years in most western countries. Therefore, knowledge of geriatric problems and specific needs of elderly patients has become increasingly important for nurses (Lyasere *et al.* 2017). Major problems in the elderly are a decrease in mobility increasing the risk of falling (Farragher *et al.* 2016) and cognitive decline and dementia (Kurella *et al.* 2006).

The aim of the present study was to investigate whether the average nursing care time needed per haemodialysis patient changed over four years as a result of changes in the characteristics of the dialysis population in this period.

MATERIAL AND METHODS

We investigated the possible changes in the average nursing care time per dialysis session for in-centre haemodialysis patients by utilising, at three different time points, a previously time-validated classification form (De Kleijn *et al.* 2015). Patients were selected from four categories of dialysis facilities: dialysis centres in university medical centres, those in general hospitals, independent dialysis centres and dialysis units without the continuous presence of physicians. We visited the same dialysis centres over a four-year period.

We included chronic dialysis patients. Excluded from measurement were patients who were undergoing dialysis for the first time and patients in an intensive care setting, as well as patients in strict isolation.

At baseline, 385 patients receiving haemodialysis were studied (all patients: baseline = AP:BL). The measurement tool was applied after one year to 538 patients (AP:BL + 1). After four years, another 476 patients (AP:BL + 4) were studied (Tables 1 and 2).

As a subgroup, incident haemodialysis patients (IP) were analysed at these time points. These were patients who had started haemodialysis a maximum of four months before the measurement point. There were 56 incident patients at baseline (IP:BL), 61 after one year (IP:BL + 1) and 60 after four years (IP:BL + 4) (Tables 1 and 2).

In a second subgroup analysis, we studied 90 patients from the baseline group who had survived a four-year follow-up period and were included in all measurements (longitudinal patients, LP) at baseline (LP:BL), after one year (LP:BL + 1) and after four years (LP:BL + 4) (Tables 1 and 2).

At all three study moments, the following patient characteristics were measured: gender, age, body mass index, length of time on dialysis, previous kidney transplantation, and previous treatment with peritoneal dialysis. The classification form to estimate nursing care time was developed with a focus on different issues that occupy nurses during a dialysis session (De Kleijn *et al.* 2015). In brief, those issues are related to patients' mobility and active participation in their own treatment (e.g. preparing the dialysis machine and applying pressure to the fistula), difficulty with vascular access, the need for psychosocial attention and haemodynamic stability during the dialysis session.

DATA ANALYSES

Statistical analysis was performed using IBM SPSS 23 (Armonk, New York, USA). To test for significant differences, either analysis of variance and χ^2 tests with post hoc analyses

	All patients (AP)			Incident patients (IP)			Longitudinal patients (LP)		
	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4
N	385	538	476	56	61	60	90	89	90
Gender									
Male (%)	56.0	59.0	61.0	66.1	59.0	64.4	53.3	53.3	53.3
Age									
Mean (years)	64	64	67	60	63*	65*	67	68	71
SD	15.3	15.9	14.9	16.2	14.0	15.4	14.6	14.1	14.5
≥75 years (%)	31.4	32.6	38.2*	19.6	19.7	38.3*	38.9	39.3	46.7
BMI									
Mean	26.2	26.0	26.2	25.3	26.0	25.6	26.4	26.5	25.7
SD	5.6	5.4	5.3	5.0	4.0	4.9	5.4	5.4	5.4
HD vintage									
Mean	3.4	3.5	4.0	0	0	0	2.8	3.8	6.8
SD	4.7	4.7	7.7	0	0	0	4.0	4.0	4.0
Previous Tx (%)	9.7	11.4*	11.2	8.9	3.3*	3.4*	7.8	7.8	10
Previous PD (%)	14.5	11.2	8.2	23.2	9.8*	8.3*	7.8	7.8	7.8
Number of comorbidities									
Mean	1.7	1.5	2.1†	1.8	1.5	2.0	1.7	1.9	2.4*†
SD	1.3	1.3	1.5	1.4	1.3	1.6	1.1	1.2	1.4

Table 1: Patient characteristics.

Including number (*N*) per measurement.
BMI: body mass index, PD: peritoneal dialysis, SD: standard deviation, Tx: transplantation.
Post hoc multiple comparisons—Bonferroni: *$p \leq 0.05$ versus BL; †$p \leq 0.05$ versus BL + 1.

	All patients (AP)			Incident patients (IP)			Longitudinal patients (LP)		
	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4
N	385	538	476	56	61	60	90	90	90
Independence									
Mobility (%)									
Walking, no help	70.1	71.7	69.5	71.4	73.8	61.7	77.8	73.0	57.8*†
Needs help	29.9	28.2	30.5	28.6	26.2	38.3	22.2	27.0	42.2*†
Patient participation before and during dialysis (%)	27.5	43.1*	60.3*†	23.2	37.7	60.0*†	21.1	40.4*	47.8*
Vascular access									
Connecting (%)									
Fistula category 1	36.4	48.3	38.0	16.1	18.0	15.0	38.9	55.1	55.6
Fistula category 2	27.5	27.5	30.5	5.4	16.4	13.3	27.8	28.1	27.8
Fistula category 3	15.8	11.2	13.2	17.9	13.1	13.3	16.7	10.1	8.9
Catheter category 1	13.5	8.7	10.1	50.0	36.1	30.0	12.2	6.7	6.7
Catheter category 2	6.8	4.3	8.2	10.7	16.4	28.3	4.4		1.1
Disconnecting (%)									
Pat. pressure	53.8	63.4*	55.9	33.9	29.5	18.3*	56.7	70.8*	60.0
Nurse pressure	26.0	23.6	25.8	5.4	18.0*	23.3*	26.7	22.5	32.8
Closing catheter	20.3	13.0	18.3	60.7	52.5	58.3	16.7	6.7*	7.8*
Extra psychosocial attention (%)	33.8	34.6	36.1	32.1	36.1	61.7*†	31.1	28.8	32.1
Complexity dialysis: Symptomatic RR dip, extra checks (%)	34.5	29.7	35.3	32.1	27.9*	46.7*†	32.2	32.6	40.0

Table 2: Dialysis characteristics.

Including number per measurement.
Post hoc multiple comparisons Bonferroni: *$p \leq 0.05$ versus BL; †$p \leq 0.05$ versus BL + 1.

were applied. For multiple comparisons, Bonferroni's corrections were performed.

ETHICAL APPROVAL

This study was reviewed by the Medical Ethics Committee.

RESULTS

GENERAL

On average, the haemodialysis patients had become significantly older after four years. In the AP group, an average age gain of three years was observed after four years, whereas the average length of time on dialysis did not change (Table 1). The increasing age of patients was also observed in the IP groups: the age of patients starting dialysis at time point BL + 4 was on average five years older than that of patients at BL (Table 1).

The number of comorbidities per patient increased significantly over time from 1.7 to 2.4 in the 90 LPs (Table 1). In the AP groups, the number of comorbidities increased from 1.7 to 2.1 (significant), but in the IP groups, the difference was not significant (Table 1).

ALL PATIENTS

The average time required by nurses to perform the dialysis procedure did not significantly change over a four-year period in the AP groups (Figure 1).

The dialysis characteristics contributing to the overall need for nursing time are shown in Table 3 and can be divided into nursing-time-consuming and nursing-time-saving activities. More patients actively participated in their treatment, which was time-saving, but this was counterbalanced by more time-consuming

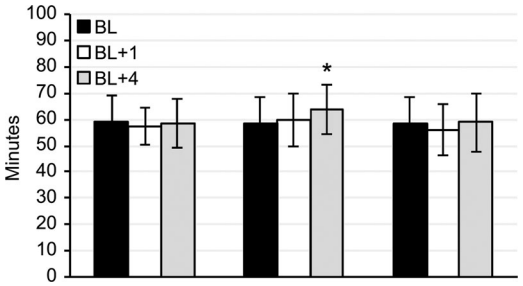

*Figure 1: Mean nursing care time. Mean (±SD) time. AP: all patients, IP: incident patients, LP: longitudinal patients, SD: standard deviation. Analysis of variance and χ^2: *$p \leq 0.05$ versus BL.*

catheter-related problems during both the connection and disconnection of catheters. As a result, the average time calculated in the AP groups did not change over time (Figure 1).

INCIDENT PATIENTS

In the IP groups, the average nursing time did increase over time. This could be attributable to a rise in the time-consuming characteristics of this patient group, including decreased patient mobility, a higher percentage of haemodynamically unstable dialysis procedures, more time needed for psychosocial attention, more catheter connectivity problems and more nursing time needed for applying pressure to fistulas. These time-consuming characteristics could not be offset by a decrease in the needed nursing time due to the more active participation of the IPs at BL + 4 years (Table 3) and are probably related to the increasing age and comorbidities of incident dialysis patients. The mean time nurses needed to care for IPs increased significantly over four years (Figure 1).

LONGITUDINAL PATIENTS

In the LP:BL + 4 group, mobility had decreased compared to that in the LP:BL group, as the percentage of patients walking independently had dropped and the number of patients needing wheelchairs had increased. These factors contributed to the need for more nursing time per patient after four years. Furthermore, there was a trend of increased time due to nurses needing to apply pressure to the fistula after the dialysis session, and the number of unstable dialysis sessions increased (both consuming more time). On the other hand, there was an increase in the number of patients actively participating in their treatment and in the number of patients with less difficult fistulae and catheters (time-saving factors). Therefore, the average needed nursing minutes per patient over time did not change in the LP group.

The lower mobility and the trend towards a higher percentage of unstable dialysis procedures may be compatible with an increase in patients' age and comorbidities.

The average care time that nurses needed for the 90 LPs remained the same, despite the fact that the patients were older and had a greater number of comorbidities (Figure 1).

DISCUSSION

In the current study, we were able to demonstrate that the nursing care time needed per haemodialysis session had not

	All patients (AP)			Incident patients (IP)			Longitudinal patients (LP)		
	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4
N	385	538	476	56	61	60	90	90	90
Independence									
Mobility									
Walking, no help	1.0	1.0	1.0	1.0	1.0	0.8[a]	1.1	1.1	0.8*†[a]
Needs help	2.8	2.7	2.7	2.5	2.3	2.6[a]	1.8	2.2[a]	4.3*†[a]
Patient participation before and during dialysis	85.9	88.6*[b]	92.2*†[b]	84.9	88.0	92.8*†[b]	84.4	87.7*[b]	89.8*[b]
Vascular access									
Connecting									
Fistula 1	7.9	10.9[b]	8.4	3.5	3.9	3.0[b]	8.6	12.7[b]	12.2[b]
Fistula 2	6.2	6.4	7.0	1.2	3.7	2.8	6.4	6.7[a]	6.3
Fistula 3	5.3	3.8	4.5	6.0	4.3	4.1[b]	5.6	3.6[b]	3.0[b]
Catheter 1	2.8	1.9	2.1[b]	10.6	7.5	5.9[b]	2.6	1.5[b]	1.4[b]
Catheter 2	2.6	1.7	3.3[a]	4.2	6.4	10.3[a]	1.8	0.0[b]	0.4[b]
Disconnecting									
Patient pressure	15.6	19.0[b]	16.5	10.0	8.5	5.0	16.7	21.8*[b]	17.5
Nurse pressure	13.4	12.6	13.6	2.8	9.3	11.2[a]	14.0	12.3	16.8[a]
Catheter	7.7	5.1	7.0	23.2	19.7	20.5[b]	6.4	2.7*[b]	3.0[b]
Extra psychosocial attention	2.2	2.4	2.4	2.1	2.4	3.8*†[a]	2.1	1.8	2.1
Complexity dialysis: Symptomatic RR dip, extra checks	4.7	4.2	4.9	4.5	3.8*	6.0*†[a]	4.5	4.7	5.5[a]

Table 3: Average percentage of time that nurses need per dialysis characteristic.

[a]More nursing-time-consuming.
[b]Less nursing-time-consuming.
Post hoc multiple comparisons Bonferroni: *$p \leq 0.05$ versus BL; †$p \leq 0.05$ versus BL + 1.

changed in a four-year period, despite the fact that after four years, both the average age and the mean number of co-morbidities of patients had increased. This can be explained by the fact that the characteristics of the nurses' job content over the years had changed in such a way that time-consuming characteristics due to, for example, the increasing age and comorbidity of dialysis patients, were counterbalanced by time-saving characteristics largely in the form of the more active participation of the patients in their treatment.

Older age in dialysis patients is often associated with frailty, which has been shown to be associated with impaired mobility and increased risk of falling in these patients. (McAdams-DeMarco *et al.* 2013; Delgado *et al.* 2015). In our study, we confirm that impaired mobility is present in elderly patients receiving dialysis as in the incident and the longitudinal patients at BL + 4 immobility is highest leading to more needed nursing time (Table 2). Likewise, has been demonstrated that elderly patients undergoing haemodialysis suffer from cognitive impairment (Jassal and Watson 2009), which we did measure as an increased need psychosocial attention in the incident patient group at BL + 4 (Table 2). As on the other hand over time the active participation of patients increased, resulting in a reduction of nursing time needed, overall needed nursing time did not change (particularly seen in the LP group, Figure 1).

Similarly, it could be anticipated that over time longer patients treated with haemodialysis become more experienced with the treatment and need less care time. Indeed, we see in all groups over time a rise in patient participation with the highest number at BL + 4 (Table 2), which could result in less needed nursing care time. This gain, however, is offset by the rise in needed nursing time due to increased immobility, number of comorbidities and need for physical attention in all patients and in the longitudinal patients.

In incident patients, the total nursing time had increased significantly at BL + 4 (Figure 1) despite the abovementioned counterbalancing effect of time-saving and time-consuming effects on nursing care time. Most likely, this can be explained by the persistent presence of catheters as dialysis access (Table 2: vascular access).

Despite current and long-standing guidelines focussing on timely vascular access placement for patients starting dialysis, incident patients still started in the majority of cases (approximately 60%) with a catheter as vascular access, resulting in more time spent connecting and disconnecting.

Ageing is associated with less physical activity and a sedentary lifestyle. This has also been demonstrated in patients receiving haemodialysis (Avesani *et al.* 2012). Thus, it is an interesting observation that over a four-year period, haemodialysis patients participated more actively in their treatment. This can be attributed to the successful implementation of recent Dutch guidelines, which call for more patient participation in their treatment. The Dutch dialysis quality improvement system is increasingly promoting dialysis guidelines. In line with Hoekstra *et al.* (2017) who demonstrated improved care for exit sites in the Netherlands after widespread guideline implementation.

Accurate staff planning is of utmost importance to achieve optimal patient outcomes. An imbalance between available nursing staff and the number of tasks per nurse leads to detrimental patient outcomes (Aiken 2002; Rafferty *et al.* 2007; Thomas-Hawkins *et al.* 2008; Estabrooks *et al.* 2011). Especially in acute and general hospital settings, it has been demonstrated that a shortage of nurses and the concomitant high number of patient care tasks per nurse results in higher 30-day mortality rates and failure to rescue (Aiken 2002; Rafferty *et al.* 2007; Estabrooks *et al.* 2011), as well as higher burnout rates and more job dissatisfaction among nurses (Aiken 2002; Rafferty *et al.* 2007). An insufficient number of nursing staff was associated with more infections resulting from less hand hygiene and more medication errors (Wolfe 2011). Thomas-Hawkins *et al.* (2008) showed that in chronic haemodialysis units, high patient-to-registered nurse ratios resulted in higher numbers of tasks left undone by the nurses. This was associated with an increased likelihood of hypotensive periods during dialysis, skipped or shortened dialysis treatments and higher numbers of patient complaints. Gardner *et al.* (2007) revealed that in dialysis units, high nurse turnover rates related to impaired job satisfaction resulted in increased patient hospitalisation rates. Thus, appropriate nurse staffing is an essential factor to achieve optimal patient outcomes. In the present study, we demonstrate no changes in needed care time over a four-year interval. Sufficient availability of nurses will contribute to greater patient engagement (Barnes *et al.* 2013) and, probably, to the more active

participation of patients in their treatment, thus reducing the nursing care time.

LIMITATIONS OF OUR STUDY

The patients for whom care time was measured were not randomly selected. However, we believe that there was only a limited possibility of selection bias because each of the dialysis patients from the various categories of dialysis centres had an equal probability of being included in the study.

RELEVANCE TO CLINICAL PRACTICE

Our study shows that nurses are increasingly confronted with elderly patients who generally require more nursing care time as these patients often are less mobile and require more attention.

We also saw that patients who start dialysis need more nursing care time. One of the reasons is that these patients do not yet participate in their dialysis treatment. This results in an increased amount of nursing time needed, for example, to close the vascular access. The best way to counterbalance the rise in nursing-time-consuming activities due to e.g. impaired mobility seems to be to train these older patients to participate in their treatment, thus decreasing the nursing-time needed. This explains why the average nursing care time in mixed groups of long-standing and incident dialysis patients remained the same over time. Our study shows that many patients including elderly participated in their treatment, so that a rise in nursing time-consuming actions was counterbalanced by time-saving actions. Thus, also actively involving elderly patients in their treatment seems to be very important. In dialysis centres with a mix of patients, nursing care time remains the same. Dialysis centres with a high turnover (and older patients), will be confronted with increasing nursing care time needed as centres with predominantly older patients. Our classification model can help optimise the planning for staffing all these dialysis departments.

CONCLUSION

In summary, we measured the average nursing care time needed per haemodialysis session in a large cohort of Dutch haemodialysis patients with a time-validated classification form. We were able to demonstrate that the average needed nursing time over a four-year period did not change because the time-consuming characteristics of the nursing care needed due to increasing age and comorbidity of the haemodialysis patients were counterbalanced by the time-saving characteristics, mainly as a result of more active participation of the patients in their treatment.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

RdK: Conceived the original idea for the study, designed and co-ordinated the study, analysed and interpreted the data, and drafted the manuscript. CU: Assisted with the study design and interpretation of results, and read and approved the final manuscript. CH: Read and approved the final manuscript. JS: Read and approved the final manuscript. CF: Revised and approved the final manuscript. PP: Analysed and interpreted the data, read and approved the final manuscript. PW: Assisted with drafting the manuscript and revised and approved the final manuscript.

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