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CASE STUDY

Caregiver-Delivered Foot Massage and Structured Family Education in Uncontrolled Essential Hypertension: An Observational Analytic Case Study of Blood-Pressure and Knowledge Outcomes

Fatimatuz Zahra[1*], Ruslinawati[1], Roly Marwan Mathuridy[1]

[1]Nurse Profession Study Programme, Faculty of Nursing and Health Sciences, Universitas Muhammadiyah Banjarmasin, Banjarmasin, Indonesia

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Corresponding author
Fatimatuz Zahra
Email
ftmzzhraa@gmail.com
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ABSTRACT

Background: Caregiver-delivered foot massage and structured education are used as non-pharmacological nursing interventions for hypertension in Indonesian community practice. Evidence from complete family nursing records remains limited.

Objective: To document one family nursing record for uncontrolled essential hypertension and quantify blood-pressure and family-knowledge outcomes using exact methods and pre-stated criteria.

Methods: An observational analytic case study followed one rural South Kalimantan household during four ADPIE contacts in April 2024. The index patient was a 46-year-old woman with uncontrolled essential hypertension; her husband was the caregiver. Three daily 30-minute bilateral foot-massage sessions were delivered as a supervised handover with leaflet-supported education. Blood pressure was measured before and after each session, and family knowledge with a 10-item interview at each visit. Exact non-parametric tests evaluated changes.

Results: Baseline blood pressure was 160/95 mmHg. Systolic pressure fell at every session by a mean 7.0 mmHg (SD 3.0; Hedges gz = -1.33), and diastolic pressure by 3.0 mmHg; exact tests returned the smallest two-sided values the design permits (0.25 systolic; 0.50 diastolic). Of the -20 mmHg net systolic change, -21 mmHg occurred within sessions. Knowledge increased from 2/10 to 10/10 (Cochran Q = 13.000; exact permutation p = 0.0009), four of five goals were attained, and no adverse event occurred.

Conclusion: The intervention was feasible, acceptable and safe, and accompanied by consistent within-session blood-pressure reductions and a large family-knowledge gain. Adequately powered multiple-baseline designs with a washout interval are needed to test persistence.

All authors have reviewed and approved the final version of the manuscript.

1. Introduction

Raised blood pressure is the leading modifiable contributor to global cardiovascular mortality, and the burden falls unevenly. A systematic review and meta-analysis of population-representative surveys from low- and middle-income countries found that, although urban prevalence was historically higher, the rural excess has grown steadily over three decades, so that rural populations now carry a comparable or greater burden with markedly poorer awareness and control.[1] Community health-worker programmes in these settings improve detection and control, but coverage remains partial and the effect on treatment continuation is modest.[2] Indonesia sits inside that pattern: analysis of the 2018 national basic health survey places adult hypertension prevalence above thirty per cent, and rural residence, agricultural occupation, older age and irregular health-service contact emerge as independent predictors of uncontrolled disease.[3,4] Screening at the community non-communicable-disease post reaches a large population, yet follow-up engagement with primary care after a positive screen is low and socially patterned,[5] and clinicians in Indonesian primary care centres identify workload, medicine supply and patient non-attendance as the principal barriers to hypertension management.[6] Community health workers and older women in rural Java describe hypertension care in explicitly holistic terms, valuing touch, companionship and dietary counselling alongside medication.[7]

Two features of this population shape what a household-level intervention has to achieve. The first is adherence. Pooled estimates place non-adherence to antihypertensive medication in comparable South and Southeast Asian populations at roughly half of all treated patients,[8] and self-care behaviour among Indonesian adults with hypertension is weakest precisely in the domains that require sustained daily action — medication-taking, low-salt eating and scheduled review.[9] Behaviour-change approaches that engage the patient's own motivation, and nurse-led strategies that scaffold memory and routine, both improve adherence more than information alone.[10,11] The second is sodium. Behavioural salt-reduction interventions lower systolic pressure by a clinically meaningful margin and reduce urinary sodium excretion,[12] with household-level and substitution strategies the most effective of the available approaches,[13] and international guidance converges on a target well below habitual intake.[14] In riverine South Kalimantan the exposure is specific: salted fish is a staple, and community survey data from a neighbouring primary-care area link sodium intake, family support and the perception of salted-food consumption directly to hypertension.[15]

Foot massage is among the most frequently chosen complementary interventions in Indonesian family nursing practice, and the evidence behind it is specific rather than general. An umbrella review of reflexology for blood pressure control found consistent short-term reductions across syntheses, with certainty limited by unblinded outcome assessment,[16] and a meta-analysis in cardiovascular patients

reported significant post-intervention falls in both systolic and diastolic pressure and in heart rate.[17] A three-arm randomised controlled trial of self-administered foot massage and reflexology in adults with hypertension found improvement in physiological parameters, sleep quality and quality of life,[18] and a randomised trial in Indonesian older adults reported reductions in both blood pressure and anxiety after foot massage.[19] Related manual techniques behave similarly: slow-stroke back massage lowered pressure, anxiety and depression in Indonesian older people,[20] foot massage combined with aromatherapy reduced blood pressure and stress responses in essential hypertension,[21] and foot massage in postmenopausal women improved anxiety, fatigue and sleep.[22] Massage therapy also improves sleep quality in acutely ill patients.[23] Mechanistically, a randomised trial of Thai foot massage in community-dwelling older adults documented immediate increases in renal blood flow, reductions in psychological stress and a parasympathetic shift in heart-rate variability,[24] which is consistent with the vascular and autonomic pathways identified for other non-pharmacological blood-pressure interventions.[25] Narrative synthesis of non-pharmacological hypertension management for community-dwelling adults in Southeast Asia places massage and relaxation techniques alongside diet and activity as the interventions most compatible with local practice,[26] while network meta-analysis and meta-analysis of psychospiritual approaches confirm that several distinct non-drug modalities produce comparable short-term reductions.[27,28]

The education and family components point in a complementary direction. Structured hypertension education raises knowledge and lifestyle practice reliably,[29] and leaflet-supported education has repeatedly moved Indonesian patients from the Poor to the Good knowledge band within a small number of sessions.[30,31] Interactive delivery outperforms self-directed reading for blood pressure control,[32] and nurse-led self-management education produces durable improvements in chronic-disease outcomes.[33,34] Interventions that engage the household rather than the patient alone perform better still: a cluster randomised trial of family-based interventions improved blood-pressure outcomes in adults,[35] a patient–family carer partnership intervention improved control in rural communities,[36] and caregiver support predicts self-care in older adults with hypertension.[37] Family nursing conversations improve patient and family outcomes in chronic illness and in stroke caregiver dyads,[38,39,40] and in Indonesian community nursing the implementation of the family health tasks is itself associated with hypertension outcomes in older adults.[41]

Orem's self-care deficit nursing theory, and specifically the supportive-educative nursing system, frames the arrangement studied here, because the nurse's action is to develop the agency of another party rather than to compensate for its absence.[42] Training built explicitly on that theory improves self-care outcomes,[43] dependent-care agency — a family member acting as the self-care agent for someone who cannot fully act for themselves — is measurable and modifiable,[44] and the model has been applied to family-based hypertension care in Indonesia.[45] Care was documented with the Indonesian standard nursing diagnosis language,[46,47] with problem priority scored on the Bailon and Maglaya instrument,[48] and mapped for this article to the NANDA-I, NIC and NOC terminologies.[49,50,51] Against that background, this study set out to document one complete family nursing record for uncontrolled essential hypertension; to quantify the within-session and between-session components of the blood-pressure change with exact, distribution-free methods; to measure the family knowledge response at item level; and to report goal attainment, patient-reported outcomes and safety.

2. Methods

2.1. Study design

This was an observational analytic case study of a single family, reported in accordance with the CARE guideline for case reports and appraised against the design standards used for single-case intervention research.[52,53] The unit of study was one household; the design is a pre-post series with a prior assessment observation, in which each intervention session supplies a matched pair of blood-pressure readings and each visit supplies one measurement of family hypertension knowledge. Care was delivered as part of a supervised professional nursing rotation; no aspect of care was assigned or manipulated for research purposes, and the analysis reported here was performed on the completed clinical record. A completed CARE checklist is supplied as a supplementary file.

2.2. Ethical approval

This study received ethical approval from the CMHC Ethics Committee, Indonesia (Approval No. CMHC/EC/2024/0186). Written informed consent was obtained from the patient and from her family caregiver prior to data collection, including consent for the publication of anonymised clinical details. The study was conducted in accordance with the Declaration of Helsinki. Care was organised throughout around the five rights of human subjects in research — self-determination, privacy and dignity, anonymity and confidentiality, justice, and beneficence with non-maleficence — and all identifying material was held in a single access-controlled location.

2.3. Setting and case selection

The study was conducted in the family home in Desa Sungai Rangas Tengah, catchment of UPT Puskesmas Martapura Barat, Kabupaten Banjar, South Kalimantan, Indonesia between 27 and 30 April 2024, with intervention sessions on 28, 29 and 30 April. The catchment is a rural riverine service area of 149.38 km^2 covering thirteen villages, in which hypertension has been the commonest presentation since January 2022. One household was selected purposively from the puskesmas hypertension register during the rotation. The index patient was an adult with a clinical diagnosis of essential hypertension and office pressure at or above 140/90 mmHg at the nursing assessment, living with a co-resident family member able and willing to be trained as caregiver; both gave written consent. Households were not eligible where the patient had an open fracture, active local inflammation of the feet, or a history of stroke, renal failure or myocardial infarction, these being the exclusions specified in the published protocol for the intervention.[16,18]

2.4. Data collection: the ADPIE nursing process

Data were collected by the first author, a final-year Ners student, using the structured family nursing assessment format of the programme, across four contacts in four days. The complete process, from assessment to the outcome statement, is summarised in **Figure 1**, and the sequence of contacts is drawn to scale in **Figure 2**.

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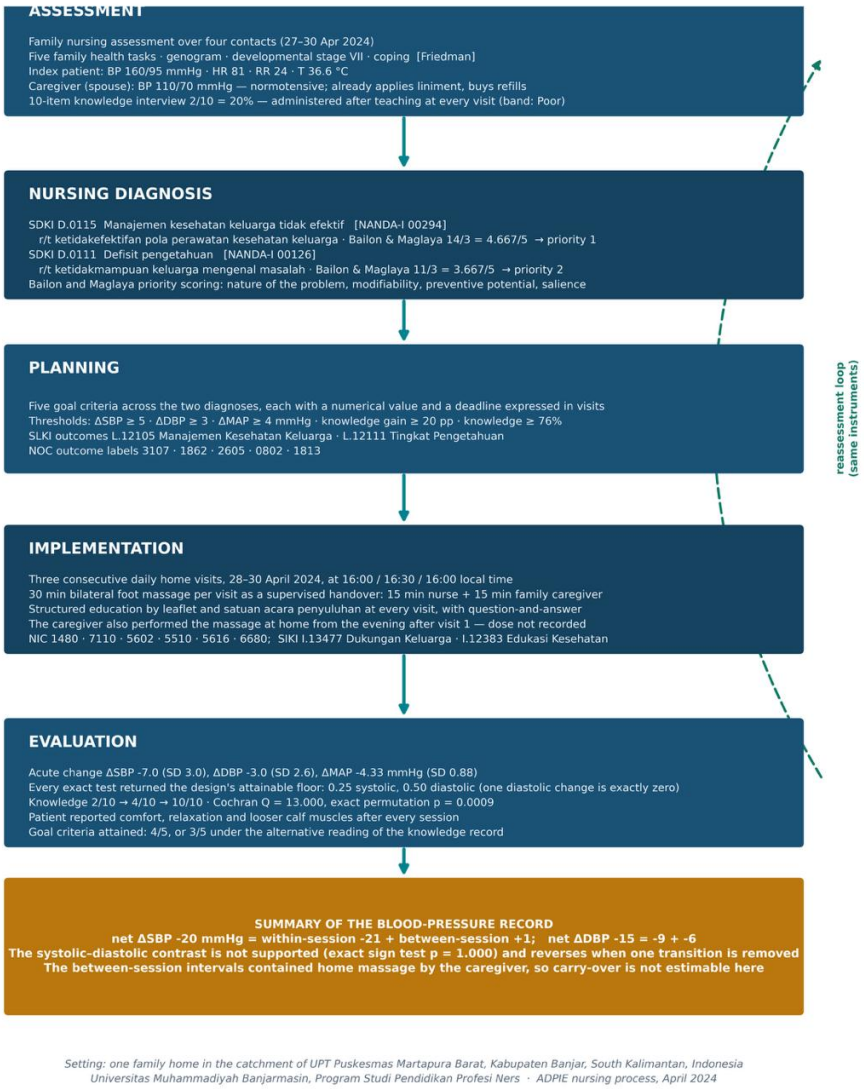

Figure 1. Nursing process implementation for uncontrolled essential hypertension in one rural household in the catchment of UPT Puskesmas Martapura Barat, Kabupaten Banjar, South Kalimantan. ADPIE = assessment, diagnosis, planning, implementation, evaluation; SDKI = Standar Diagnosis Keperawatan Indonesia; NIC = Nursing Interventions Classification; NOC = Nursing Outcomes Classification.

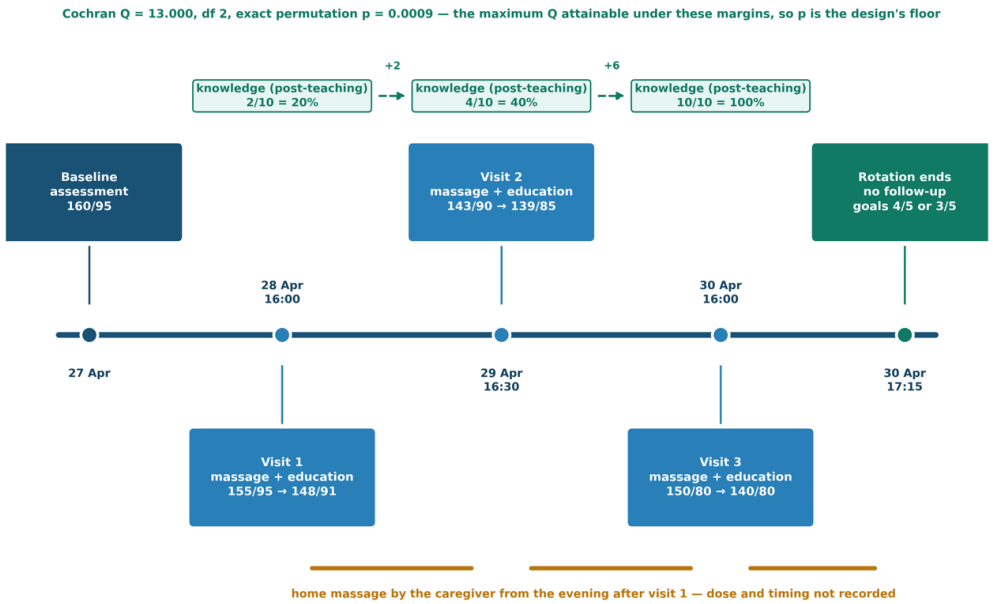

Figure 2. Clinical timeline of family nursing care, showing the four contacts, the paired blood-pressure readings at each intervention session, the caregiver's home massage from the evening after visit 1, and the parallel trajectory of the 10-item family hypertension knowledge interview.

Assessment. The nursing assessment covered family structure and developmental stage, the genogram, the five family health tasks, communication and decision-making, stress and coping, and physical examination of both household members.[41] Blood pressure was measured with an aneroid sphygmomanometer and stethoscope, with the patient seated and the arm supported at heart level, at every contact and by the same observer using the same device and cuff throughout. Heart rate, respiratory rate and axillary temperature were recorded once per contact. Family hypertension knowledge was assessed with a 10-item structured interview administered to the patient and caregiver jointly, covering the definition of hypertension, its causes, its signs and symptoms, normal blood-pressure values, home care, control measures, complications, prohibited foods, prevention and care-seeking. The total was expressed as a percentage and classified as Good (76–100%), Sufficient (56–75%) or Poor (below 56%), the bands conventionally applied in Indonesian community nursing research.[30,31]

Nursing diagnosis. Diagnoses were formulated against the Indonesian Standar Diagnosis Keperawatan Indonesia, with outcomes taken from the SLKI and interventions from the SIKI, which together form the standardised nursing language in Indonesian practice.[46,47] Each diagnosis was additionally assigned its corresponding NANDA-I 2021–2023 code, and the associated NIC and NOC labels, so that the care plan can be read against the international terminologies.[49,50,51] Problem priority was scored with the Bailon and Maglaya instrument, which weights four criteria — the nature of the problem, its modifiability, its preventive potential and its salience to the family — and yields a total out of five as a triage rank.[48]

Planning. Goals were set for each diagnosis with an explicit numerical criterion and a deadline expressed in visits, so that attainment could be judged against a stated value rather than a descriptive impression. Five goal criteria were specified across the two diagnoses, and four measurement thresholds were adopted for the continuous outcomes: 5 mmHg for systolic pressure, 3 mmHg for diastolic pressure, 4 mmHg for mean arterial pressure and 20 percentage points for the knowledge score. The systolic value is the increment associated with an approximately ten per cent reduction in major cardiovascular events in the individual-participant-data meta-analysis of blood-pressure-lowering treatment.[54] The remaining three are conventional measurement thresholds adopted for this study and are not anchored to patient-perceived importance.

Implementation. Each of the three visits delivered a 30-minute bilateral foot massage under a written standard operating procedure, structured as a supervised handover: the student nurse performed the first 15 minutes while explaining and demonstrating each manoeuvre, and the family caregiver performed the second 15 minutes under observation and correction. Technique followed the published protocol — effleurage of the dorsum and sole, thumb-walking of the reflex zones, circular pressure at fixed points, and passive mobilisation — with a neutral emollient, the patient seated or semi-recumbent as she preferred.[16,19] Education was delivered with a printed leaflet and a satuan acara penyuluhan, with a question-and-answer period at every visit, and covered the content areas of the knowledge interview together with medication routine, sodium restriction and scheduled review.[32] Interventions were classified retrospectively against the Nursing Interventions Classification.[50] The record documents that the caregiver also performed the massage at home, on his own initiative, from the evening after the first visit; this additional dose was neither timed nor counted, and is reported in Section 3.7 and taken into account in Section 4.2.

Evaluation. Blood pressure was measured immediately before the massage began and after the session ended, using the same device, arm and position. The knowledge interview was re-administered at every visit following the education component. Progress was recorded in SOAP format, and goal attainment was judged at the final contact against the criteria set at the planning stage.

2.5. Outcome measures

The primary outcome was the within-session change in systolic blood pressure. Secondary outcomes were the within-session change in diastolic pressure, in mean arterial pressure — calculated as diastolic pressure plus one third of the pulse pressure — and in pulse pressure; the change in the pre-session readings across the three visits; the family hypertension knowledge score; goal attainment; patient-reported comfort; and adverse events. Mean arterial pressure and pulse pressure are deterministic functions of the two measured values and are not independent endpoints; each outcome, its instrument and its threshold are reported with the results in Section 3.

2.6. Statistical analysis

All analyses were performed in Python 3.10 with NumPy 2.2. Every tail probability reported as exact is enumerated or computed in closed form; where an asymptotic value is also given it is labelled as such. The analysis script and the verification harness are supplied as supplementary files so that every value in this article can be reproduced from the raw readings.

Acute response. Within-session change was computed for each of the four pressure measures. With three paired observations the inference is distribution-free: an exact sign test, an exact Wilcoxon signed-rank test with the full reference set enumerated (zeros excluded by Wilcoxon's convention), and an exact sign-flip randomisation test on the mean. Effect sizes are reported as Hedges-corrected g_z, the small-sample correction being material at two degrees of freedom; the uncorrected Cohen's d_z is shown alongside for comparison. Because a sign, signed-rank or sign-flip test on k non-zero paired observations draws from 2k equally likely sign assignments, the smallest two-sided probability such a test can return is $2 \times (1/2)k$. That value was computed for each measure, taking ties into account, and is reported with every result so that a non-significant outcome can be read for what it is. The power of a two-sided sign test was computed by exact enumeration across a range of session counts and per-session response probabilities, and the minimum detectable mean change at eighty per cent power was computed at the observed dispersion.

Partition of the record. The blood-pressure record consists of a baseline assessment reading followed by a pre- and a post-session reading at each of three visits. The change from the first to the last reading is the exact sum of the three within-session changes and the three between-session changes, and the record is reported in that form so that the fraction of the total change occurring inside treatment sessions is visible. Whether the systolic and diastolic between-session components differ was tested by forming their paired contrast, transition by transition, and applying an exact sign test and an exact sign-flip randomisation test. Sensitivity was assessed by leave-one-transition-out and by propagating terminal-digit rounding through the linear combination of six readings that constitutes a between-session sum. The three pre-session readings, each a

first reading of its own day, were additionally analysed as a trend with Kendall's τ_b and an exact permutation probability over all distinct orderings.

Knowledge. The 10-item interview administered at three visits forms a 10 × 3 matched binary design and was analysed with Cochran's Q, with an exact permutation probability computed over the complete reference set of admissible arrangements, and with exact McNemar tests for each pair of visits, Holm-adjusted across the three comparisons. The maximum value of Q attainable under the observed margins was enumerated and is reported with the result. Because the narrative record supports two readings of which content areas were answered correctly at the second visit, the item-level matrix was reconstructed under both readings and both were analysed. Proportions carry Wilson score intervals.

Sensitivity analyses. Three sources of variation that operate on measurements of this kind were quantified against published benchmarks: settling of pressure across sequential readings taken in one sitting, for which the reference envelope is the rest-period trial;[55] terminal-digit preference in manual auscultatory measurement, tested with an exact one-sided binomial test against the twenty per cent expected under no preference; and cuff and technique factors known to affect oscillometric and auscultatory accuracy.[56,57] Regression to the mean was examined by exact permutation of the pre-value–change correlation over all attainable orderings. Each intervention delivered was assigned a level of evidence on the standard hierarchy used in evidence-based nursing practice, which classifies the strength of the external evidence supporting a practice.[58]

3. Results

3.1. Case description

One household was studied between 27 and 30 April 2024. The index patient was a 46-year-old woman, a rice farmer, with a clinical diagnosis of essential hypertension and a positive first-degree family history, presenting with intermittent posterior neck and occipital pain and stiffness and with initial insomnia and frequent night waking. Her full demographic, clinical and household profile is set out in **Table 1**. Poor sleep is itself associated with higher and less well-controlled pressure in older adults with hypertension, and the same association has been reported in Indonesian primary-care populations.[59,60] At the nursing assessment her blood pressure was 160/95 mmHg — a calculated mean arterial pressure of 116.7 mmHg and pulse pressure of 65 mmHg — which is grade 2 hypertension on the classification used in the record, the grade being determined by the higher of the two categories, which here is the systolic one. Heart rate was 81 beats per minute, temperature 36.6 °C, and respiratory rate 24 breaths per minute. She took her antihypertensive only when headache worsened, kept no therapeutic diet, ate salted fish almost daily and attended no routine review — the pattern of partial, symptom-driven self-care described in Indonesian survey data.[9] Her husband, aged 52 and also a rice farmer, was normotensive at 110/70 mmHg. His caregiving role before entry was limited to buying medication refills and rubbing liniment on her neck when it ached; he did not remind or supervise her medication, and took no part in meal planning. The household had already reduced salty food to some degree.

Table 1. Demographic, clinical and household profile of the case.

Domain	Characteristic	Value
Index patient		
	Age, sex	46 years, female
	Occupation	Rice farmer, works daily in the field
	Clinical diagnosis	Essential (primary) hypertension
	ICD-10 code	I10
	Duration of known hypertension	Diagnosed at a health facility after persistent nuchal pain
Clinical status at entry		
	Blood pressure	160/95 mmHg
	Mean arterial pressure	116.7 mmHg
	Pulse pressure	65 mmHg
	Blood-pressure grade	Grade 2 hypertension, assigned on the higher of the two categories (systolic grade 2, diastolic grade 1)
	Other vital signs	Heart rate 81 beats/min · respiratory rate 24 breaths/min · temperature 36.6 °C
Symptoms and risk profile		
	Presenting symptoms	Intermittent posterior neck and occipital pain and stiffness; initial insomnia with frequent night waking
	Family history	Positive first-degree family history of hypertension
	Dietary exposure	No therapeutic diet; salted fish (ikan asin) eaten almost daily; both spouses eat the same menu; the household had already reduced salty food to some degree before entry
	Antihypertensive	Taken only when headache worsens; no routine daily dosing
	Health-service contact	No routine puskesmas review; presents only when symptoms become severe
Household		
	Family structure	Two-person middle-age family (Friedman developmental stage VII); the couple had one child, who died some years previously
	Principal caregiver	Husband, 52 years, rice farmer; blood pressure 110/70 mmHg (optimal), heart rate 89 beats/min
	Caregiver role before entry	Buys medication refills; rubs liniment on the patient's neck when it aches; does not remind,

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Domain	Characteristic	Value
		supervise or participate in meal planning
	Decision-making and communication	Deliberative, led by the husband; communication intact; both spouses socially active
	Setting	Family home in desa sungai rangas tengah, catchment of upt puskesmas martapura barat, kabupaten banjar, south kalimantan, indonesia
	Study period	27–30 April 2024; intervention sessions on 28, 29 and 30 April 2024, at 16:00, 16:30 and 16:00 local time

Mean arterial pressure = diastolic + (systolic − diastolic)/3 and is a deterministic function of the two measured values rather than an independent measurement. Household details are given at the level needed to interpret the case; the village sub-unit, the child's cause of death and the case's rank in the village register have been withheld to protect identifiability. ICD-10 = International Classification of Diseases, 10th revision.

3.2. Nursing diagnoses, priority and the care plan

Two nursing diagnoses were formulated from the assessment findings, and are set out with their related factors, defining characteristics, goal criteria, interventions and attainment in **Table 2**. Ineffective family health self-management (SDKI D.0115; NANDA-I 00294), related to an ineffective family health-care pattern, scored 14/3 = 4.667 of a possible 5.000 on the Bailon and Maglaya instrument and was ranked first. Deficient knowledge (SDKI D.0111; NANDA-I 00126), related to the family's inability to recognise the health problem — the first of the five family health tasks — scored 11/3 = 3.667 and was ranked second. The complete nursing process, with both diagnoses, their NIC interventions and their NOC outcomes, is summarised in **Figure 1**, and the sequence of contacts with the paired readings and the parallel knowledge trajectory is shown in **Figure 2**.

Table 2. Nursing care plan: diagnoses, goal criteria, interventions with the level of the supporting external evidence, outcome measures and attainment.

Nursing diagnosis	Goal criterion	Intervention (NIC / SIKI)	Outcome measure	Level of the external evidence	Attained?
SDKI D.0115 — Manajemen kesehatan keluarga tidak efektif, r/t ketidakefektifan pola perawatan kesehatan keluarga. Corresponding to NANDA-I 00294 Ineffective family health self-management. Evidenced by symptom-triggered medication use, absent routine review, absent therapeutic diet and a caregiver with a role limited to buying refills and applying liniment. Bailon and Maglaya priority score 14/3 = 4.667/5.000, ranked first. SLKI outcome L.12105 Manajemen Kesehatan Keluarga.					
	By visit 3, the family caregiver performs the complete foot-massage protocol without prompting or correction	NIC 1480 Simple Massage · NIC 7110 Family Involvement Promotion · SIKI I.13477 Dukungan Keluarga Merencanakan Perawatan — 30 min bilateral foot massage per visit as a supervised handover (15 min nurse, 15 min caregiver), written SOP, 3 consecutive daily sessions	NOC 2605 Family Participation in Professional Care; caregiver self-report in the SOAP subjective field	Level I for the acute pressure effect (umbrella review and meta-analyses of randomised trials of massage and foot reflexology); weaker for a sustained effect	**Attained** (visit 3)
	Mean arterial pressure falls by ≥ 4 mmHg in at least 2 of the 3 sessions	NIC 1480 Simple Massage · NIC 6680 Vital Signs Monitoring — single paired measurement immediately before and after each session	NOC 0802 Vital Signs · observed ΔMAP -4.33 mmHg (SD 0.88)	Level I; mean arterial pressure is derived from the two measured values	**Attained** (2/3)
	By visit 3, at least one pre-session systolic reading is below 140 mmHg	NIC 4040 Cardiac Care · NIC 5616 Teaching: Prescribed Medication — adherence counselling, encouragement to resume routine review	NOC 3107 Self-Management: Hypertension · lowest observed pre-session systolic 143 mmHg	Level I for nurse-led self-management support	**Not attained**
SDKI D.0111 — Defisit pengetahuan, r/t ketidakmampuan keluarga mengenal masalah (the first of Friedman's five family health tasks, and a standard Indonesian community-nursing etiology), corresponding to NANDA-I 00126 Deficient knowledge. Evidenced by inability to state the normal blood-pressure range, its causes or its control measures. Bailon & Maglaya priority score 11/3 = 3.667/5.000, ranked second. SLKI outcome L.12111 Tingkat Pengetahuan.					
	By visit 3, the family answers ≥ 76% of the 10-item	NIC 5602 Teaching: Disease Process · NIC 5510 Health Education · SIKI I.12383	NOC 1862 Knowledge: Hypertension Management	Level I for structured hypertension education and for	**Attained** (visit 3)

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Nursing diagnosis	Goal criterion	Intervention (NIC / SIKI)	Outcome measure	Level of the external evidence	Attained?
	interview correctly (band: Good)	Edukasi Kesehatan — leaflet and satuan acara penyuluhan, delivered at each of 3 visits with question-and-answer	· 2/10 → 4/10 → 10/10	nurse-led self-management support	
	By visit 2, the family states the normal blood-pressure range correctly	NIC 5602 Teaching: Disease Process — targeted re-teaching of threshold values	NOC 1813 Knowledge: Treatment Regimen · item-level detail in Table 6	Level I	**Attained** under the primary reading

Attainment is 4 of 5 under the primary reading of the item-level knowledge record and 3 of 5 under the alternative reading, the two differing only in the visit-2 goal (Table 6). Levels of evidence classify the external evidence supporting each intervention on the I–VII hierarchy used in evidence-based nursing practice; they do not grade the findings of the present study. SDKI = Standar Diagnosis Keperawatan Indonesia; SLKI = Standar Luaran Keperawatan Indonesia; SIKI = Standa r Intervensi Keperawatan Indonesia; NIC = Nursing Interventions Classification; NOC = Nursing Outcomes Classification; r/t = related to; SOP = standard operating procedure.

3.3. Acute (within-session) response

Paired blood-pressure readings were obtained at all three sessions with no missing data. Systolic pressure fell at every session, by 7, 4, 10 mmHg respectively, a mean of -7.0 mmHg (SD 3.0; Hedges g_z = -1.33). Diastolic pressure fell by 4, 5, 0 mmHg, a mean of -3.0 mmHg (SD 2.6; g_z = -0.65), the third session showing no diastolic change. Mean arterial pressure fell at every session, by a mean of -4.33 mmHg (SD 0.88). Pulse pressure changed by -3, +1, -10 mmHg, rising at the second session because diastolic pressure fell further than systolic. Every paired value and per-session change is listed in **Table 3**, and the trajectory across the whole intervention period is plotted in **Figure 3**a. Measured against the thresholds set at the planning stage, the systolic change reached or exceeded 5 mmHg in 2 of 3 sessions, the diastolic change reached or exceeded 3 mmHg in 2 of 3, and mean arterial pressure reached or exceeded 4 mmHg in 2 of 3; **Figure 3**b plots each session's change against its threshold.

Table 3. Measurement instruments, paired outcome scores across the three intervention sessions, and the threshold set for each measure.

Instrument	Quantity	Visit 1	Visit 2	Visit 3	Mean (SD)	Threshold	Interpretation
Systolic blood pressure (mmHg, single auscultatory reading)							
	Pre-session	155	143	150	—	—	All three above 140 mmHg
	Post-session	148	139	140	—	—	One of three below 140 mmHg
	Within-session change	-7	-4	-10	-7.0 (3.0)	≥ 5	Threshold met in 2 of 3 sessions
	Hedges-corrected g_z				-1.33	—	Uncorrected d_z would read -2.33
Diastolic blood pressure (mmHg, single auscultatory reading)							
	Pre-session	95	90	80	—	—	Non-increasing across days
	Post-session	91	85	80	—	—	Two of three below 90 mmHg
	Within-session change	-4	-5	+0	-3.0 (2.6)	≥ 3	Threshold met in 2 of 3; one change is exactly zero
Mean arterial pressure (mmHg, derived: not an independent measurement)							
	Pre → post	115.0→110.0	107.7→103.0	103.3→100.0	—	—	Falls at every session
	Within-session change	-5.00	-4.67	-3.33	-4.33 (0.88)	≥ 4	Threshold met in 2 of 3
Family hypertension knowledge (0–10 items, locally constructed, administered after teaching at every visit)							
	Items correct	2/10	4/10	10/10	gain 80 pp	≥ 20 pp	Threshold met at every step
	Percentage	20%	40%	100%	—	≥ 76%	Knowledge band Poor → Poor → Good
	Wilson 95% CI	5.7–51.0	16.8–68.7	72.2–100.0	—	—	Visit-3 lower bound 72.2%, just below the 76% criterion
Secondary vital signs (recorded once per visit)							
	Heart rate (beats/min)	80	82	78	baseline 81	—	Single reading per contact; not paired across the session
	Respiratory rate (breaths/min)	20	22	22	baseline 24	—	Change from baseline -2 breaths/min
	Temperature (°C)	36.6	36.6	36.0	baseline 36.6	—	Afebrile throughout

The 5 mmHg systolic threshold is the increment associated with an approximately 10% reduction in major cardiovascular events in the individual-participant-data meta-analysis of blood-pressure-lowering treatment; the 3 mmHg diastolic, 4 mmHg mean arterial pressure and 20 percentage-point knowledge values are conventional measurement thresholds. They are termed thresholds rather than minimal clinically important differences, an MCID being anchored by definition to what a patient perceives as important. Effect sizes are reported as Hedges-corrected g_z (J = 0.5714 on 2 degrees of freedom), the small-sample correction being material at three observations. Wilson intervals are computed over the 10 interview items. SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure; PP = pulse pressure; CI = confidence interval.

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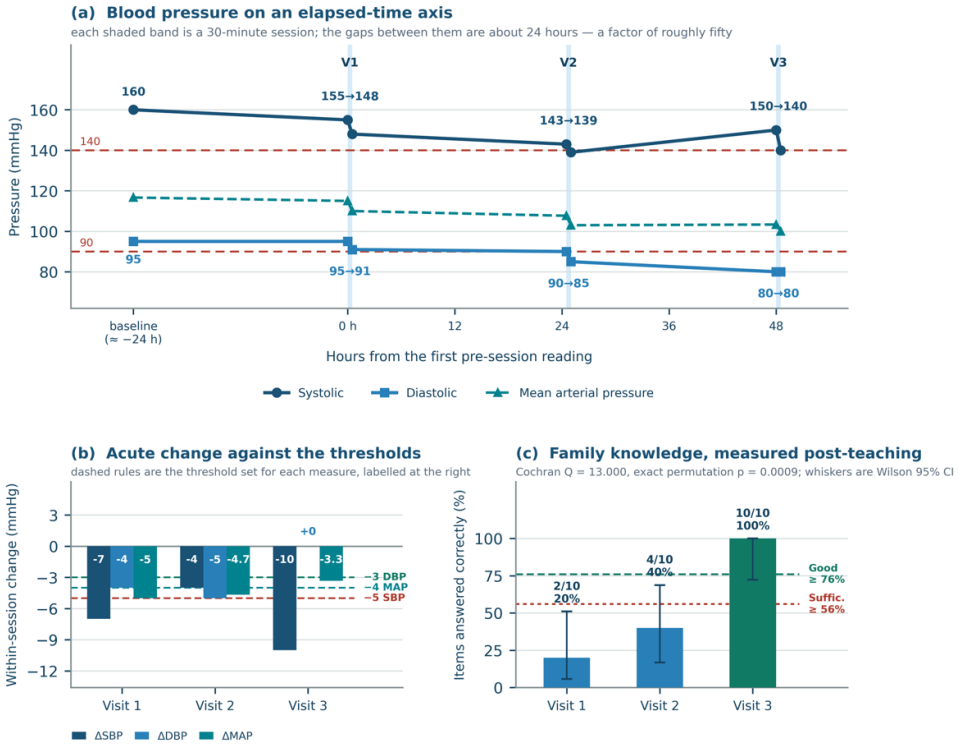

Figure 3. Outcome changes during the intervention period. (a) Blood pressure on an elapsed-time axis, with the three 30-minute foot-massage sessions shaded; note that the within-session and between-session intervals differ by a factor of about fifty. (b) Within-session change at each visit against the threshold set for that measure. (c) Family hypertension knowledge with Wilson 95% confidence intervals. SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure.

The exact inferential results are set out in **Table 4**, together with the detection limit of each test. For systolic pressure and for mean arterial pressure all three differences are non-zero, so the reference set contains $2^3 = 8$ sign assignments and the smallest two-sided probability obtainable is 0.25; the sign, Wilcoxon and sign-flip tests all returned that value. For diastolic pressure one difference is exactly zero, so under Wilcoxon's zero-exclusion convention 2 pairs remain, the floor rises to 0.50, and that is what was returned. The direction of effect was therefore uniform across measures and sessions, while the probabilities attached to it are bounded below by the size of the design rather than by the size of the effect.

Table 4. Exact analysis of the within-session (acute) response, with the detection limits the design imposes.

Measure	Per-session change	Mean (SD)	g_z (d_z)	Non-zero pairs	Two-sided floor	Sign test p	Wilcoxon p	Sign-flip p
Systolic (mmHg)	-7, -4, -10	-7.0 (3.0)	-1.33 (-2.33)	3	0.250	0.250	0.250	0.250
Diastolic (mmHg)	-4, -5, +0	-3.0 (2.6)	-0.65 (-1.13)	2	0.500	0.500	0.500	0.500
Mean arterial pressure (derived)	-5.00, -4.67, -3.33	-4.33 (0.88)	-2.81 (-4.91)	3	0.250	0.250	0.250	0.250
Pulse pressure (derived)	-3, +1, -10	-4.0 (5.6)	—	3	0.250	1.000	—	—
Detection limits								
Smallest observed mean that would be declared significant	systolic 7.45 · diastolic 6.57 mmHg	power at that value 0.617						
Minimum detectable mean change at 80% power, at the observed dispersion	systolic 9.77 · diastolic 8.61 mmHg	d_z 3.26						
Power of a two-sided sign test at 6 paired sessions	0.531 if a fall occurs on 90% of sessions; 0.262 if on 80%	12–23 sessions needed for 80% power						

*n = 3 paired sessions. The **two-sided floor** column is the smallest p that a sign, signed-rank or sign-flip test could return for that measure, given its number of non-zero pairs: 0.25 for systolic pressure and **0.50 for diastolic pressure**, where one change is exactly zero and only 2 pairs remain (Wilcoxon's zero-exclusion convention). Every observed p equals its own floor: each observed value equals the floor of its own test. A one-sided test would have a floor of (1/2)^k and would first reach p < 0.05 at 5 sessions; a two-sided test first reaches it at 6. Attainability is not the same as power: at six sessions a two-sided sign test has 0.53–0.26 power, and 12 to 23 sessions are needed for 80%. Paired-t intervals are not reported: on 2 degrees of freedom they assume a normal sampling distribution that three observations cannot evidence. The systolic and diastolic within-session changes are strongly negatively correlated in this record (r = -0.945, exact permutation p = 0.333), which is an arithmetic property of the three differences. Both detection quantities are computed at the dispersion observed here and describe the design for replication. SD = standard deviation; CI = confidence interval.*

The design's detection characteristics were quantified so that these values can be interpreted, and are given in the lower panel of **Table 4**. A two-sided test of this kind first becomes capable of returning a probability below 0.05 at 6 paired sessions, and a one-sided test at 5. Attainability is not the same as power: at six paired sessions a two-sided sign test has a power of 0.531 if a fall occurs on ninety per cent of sessions and 0.262 if on eighty per cent, and reaching eighty per cent power requires about 12 sessions in the first case and 23 in the second. At the observed dispersion, the smallest mean change that would be declared significant is 7.45 mmHg systolic and 6.57 mmHg diastolic, corresponding to about 62% power, and the minimum detectable mean change at eighty per cent power is 9.77 mmHg systolic and 8.61 mmHg diastolic. These quantities are computed at the dispersion observed in this study and describe the design prospectively for replication.

3.4. Partition of the blood-pressure record

Across the whole record, systolic pressure changed from 160 mmHg at the nursing assessment to 140 mmHg after the final session, a net change of -20 mmHg, and diastolic pressure from 95 to 80 mmHg, a net change of -15 mmHg. **Table 5** partitions those same readings into their within-session and between-session components and **Figure 4** plots the partition, panel (a) as a waterfall across the systolic record and panel (b) as the two summed components with their sensitivity analyses.

Table 5. Partition of the blood-pressure record into within-session and between-session components, the contrast between them, and its sensitivity.

Quantity	Systolic	Diastolic	Mean arterial pressure	Comment
The partition (an identity, not an estimate)				
Baseline assessment → final post-session reading	160 → 140	95 → 80	116.67 → 100.00	The net change a conventional report would present
Net change	-20	-15	-16.67	
Sum of the three within-session changes	-21	-9	-13.00	Each is a 30-minute pre/post pair
Sum of the three between-session changes	+1	-6	-3.67	Each spans about 24 hours of unmeasured behaviour
Is the systolic/diastolic difference real?				
Between-session changes, transition by transition	-5, -5, +11	+0, -1, -5	—	The systolic +11 followed a day of farm labour and a salted-fish meal
Paired contrast (systolic – diastolic) per transition	-5, -4, +16		mean 2.333	Two of three transitions favour the opposite direction
Exact test of the contrast	sign test p = 1.000	sign-flip p = 1.000		**Both at the maximum attainable value. The asymmetry is not supported.**
Sensitivity				
Between-session sums using only the first two transitions	-10	-1	—	**The direction reverses**: systolic now carries ten times more than diastolic
Standard deviation of a between-session sum under terminal-digit rounding alone	± 3.54 mmHg	± 3.54 mmHg	—	Six single readings, each rounded to within ±2.5 mmHg
Observed between-session sum, in units of that rounding noise	0.28 SD	1.70 SD	—	Neither is distinguishable from rounding

*The partition is an algebraic identity — for any sequence of readings the total change equals the sum of the consecutive differences however they are grouped — so it cannot fail and is not evidence of anything on its own. It is proposed here as a **reporting convention**, because a report that gives only the net change invites a durability inference the record does not license. The identity also splits measurement error with opposite signs across the two components: an error in a pre-session reading adds to one and subtracts from the other, so a single high pre-reading manufactures both a large acute fall and an absent carry-over. That is exactly what the day-3 reading of 150 mmHg does here. Finally, and decisively, the between-session interval is **not free of the intervention**: the record states that the caregiver began performing the massage unsupervised on the evening after the first visit, so the between-session component contains an unknown dose of untimed massage and cannot be read as the absence of a carry-over effect.*

The three within-session changes sum to -21 mmHg systolic and the three between-session changes to +1 mmHg; for diastolic pressure the split is -9 and -6 mmHg. The two components reproduce the net change exactly, and the fraction of the total systolic change that occurred inside treatment sessions is therefore directly readable. Whether the systolic and diastolic between-session components differ was tested: their paired contrast, transition by transition, is -5, -4, +16 mmHg, with a mean of 2.333, and an exact sign test returns p = 1.000 with an exact sign-flip randomisation test returning p = 1.000. The difference between the two components is therefore not supported. Two sensitivity analyses, reported in the lower rows of **Table 5**, bear on the same question. Over the first two transitions alone the systolic between-session sum is -10 mmHg and the diastolic -1 mmHg, so the direction reverses when the third transition of +11 mmHg — the day the record attributes to farm labour and a further salted-fish meal — is removed. And because a between-session sum is a linear combination of six single readings, each subject to terminal-digit rounding of up to ±2.5 mmHg, rounding alone gives such a sum a standard deviation of 3.54 mmHg, placing the observed values 0.28 and 1.70 standard deviations from zero.

The three pre-session readings were analysed separately, each being a first reading of its own day. Including the baseline

assessment, systolic pressure ran 160, 155, 143, 150 mmHg, which is not monotone (Kendall τ_b = -0.667, exact permutation p = 0.333); diastolic pressure ran 95, 95, 90, 80 mmHg, monotonically non-increasing with the first transition flat, a total fall of 15 mmHg (τ_b = -0.913, exact p = 0.167); and mean arterial pressure ran 116.67, 115.00, 107.67, 103.33 mmHg (τ_b = -1.000, exact p = 0.083). Both small probabilities sit at the attainable floor for four observations. All three sessions were held in the late afternoon, between 16:00 and 17:00 local time.

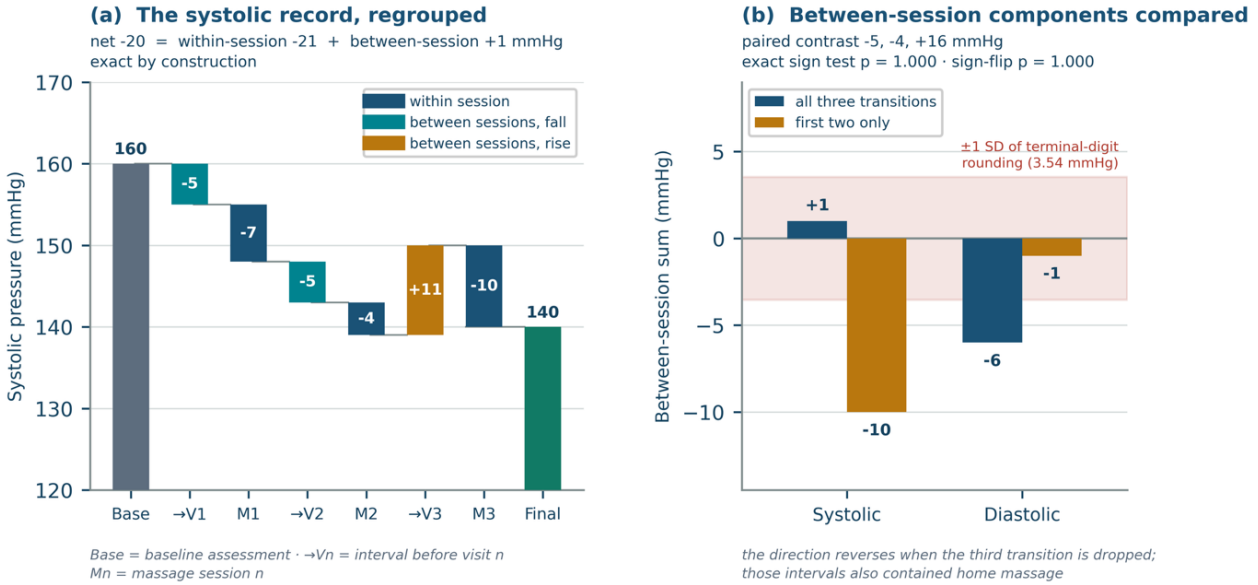

Figure 4. Partition of the blood-pressure record into within-session and between-session components. (a) The systolic record as a waterfall from the baseline assessment to the final post-session reading. (b) The two components summed over the three visits, with the exact test of the systolic–diastolic contrast and the leave-one-transition-out sensitivity analysis. The partition is exact by construction and is reported so that the fraction of the total change occurring inside treatment sessions is visible.

3.5. Family knowledge

The family answered 2 of 10 items correctly at the first visit (20%, Wilson 95% CI 5.7–51.0%), 4 of 10 at the second (40%, 16.8–68.7%) and all 10 at the third (100%, 72.2–100.0%), an absolute gain of 80 percentage points that crossed from the Poor band to the Good band and exceeded the 20-percentage-point threshold set at the planning stage. **Figure 3**c plots the three proportions with their intervals. The interview was administered after each visit's teaching, so each score is a post-education measurement; the Wilson lower bound at the third visit (72.2%) lies just below the 76% criterion, so the Good band is reached by the point estimate rather than by the whole interval.

The item-level pattern is set out in **Table 6**, which gives both readings of the narrative record: the two differ only in which content areas were credited at the second visit, and the totals are identical. Cochran's Q for the 10 × 3 matched binary design was 13.000 on 2 degrees of freedom, with an asymptotic p of 0.001503 and an exact permutation p, computed over the complete reference set of 6,561 admissible arrangements, of 0.000914. Because Q depends only on the row and column margins it is identical under both readings, so the inference is unaffected by that ambiguity. Exact McNemar comparisons show 2 items gained and none lost between the first and second visits (p = 0.5000; Holm-adjusted 0.5000), 6 gained between the second and third (p = 0.0312; Holm 0.0625), and 8 gained across the whole period (p = 0.0078; Holm 0.0234). No item was lost once gained. This is the only outcome in the study to reach conventional statistical significance, and its magnitude is bounded by the same consideration that applies to the blood-pressure tests: Q = 13.000 is the largest value attainable given these margins, tied by 6 of the 6,561 arrangements, so p = 0.000914 is this design's floor.

Table 6. Item-level results of the 10-item family hypertension knowledge interview across the three visits, under both readings of the record.

#	Content area	Reading A: V1	A: V2	A: V3	Reading B: V1	B: V2	B: V3
1	What hypertension is	✓	✓	✓	✓	✓	✓
2	Causes of hypertension	✓	✓	✓	✓	✓	✓
3	Signs and symptoms	✗	✓	✓	✗	✓	✓
4	Normal blood-pressure values	✗	✓	✓	✗	✗	✓
5	Home care of the patient	✗	✗	✓	✗	✗	✓
6	How to control blood pressure	✗	✗	✓	✗	✗	✓
7	Complications of hypertension	✗	✗	✓	✗	✗	✓
8	Foods to avoid	✗	✗	✓	✗	✗	✓
9	Prevention measures	✗	✗	✓	✗	✓	✓

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#	Content area	Reading A: V1	A: V2	A: V3	Reading B: V1	B: V2	B: V3
10	When to seek health care	✗	✗	✓	✗	✗	✓
	Total correct (of 10)	**2**	**4**	**10**	**2**	**4**	**10**
	Cochran's Q / exact permutation p	**13.000**		**0.000914**	**13.000**		**0.000914**
	Goal: normal BP value stated by visit 2	**Attained**			**Not attained**		

The narrative record names the content areas answered correctly on each day and supports two readings of the second visit — one crediting the definition, cause, signs and the normal value, the other crediting cause, signs and prevention — which are given here as readings A and B; the visit totals are identical under both. Cochran's Q depends only on the row and column margins and is therefore the same under both readings (13.000, df 2, exact permutation p = 0.000914 over 6,561 arrangements); only attainment of the visit-2 goal differs. Q = 13.000 is the largest value attainable given these margins — 6 of the 6,561 arrangements tie it — so p = 0.000914 is the floor of this design, in the same sense used in Table 4. Exact McNemar tests: visit 1 vs 2, 2 items gained and 0 lost, p = 0.5000 (Holm 0.5000); visit 2 vs 3, 6 gained, p = 0.0312 (Holm 0.0625); visit 1 vs 3, 8 gained, p = 0.0078 (Holm 0.0234). Under strict nesting the third comparison is determined by the first two, so the family contains two free comparisons and the Holm adjustment is conservative. ✓= answered correctly; ✗ = not answered correctly; V1–V3 = visits 1 to 3; BP = blood pressure.

3.6. Goal attainment, patient-reported outcomes and adverse events

Of the five goal criteria, 4 were attained and one was not under the primary reading of the knowledge record, and 3 of 5 under the alternative reading, the difference being the goal requiring the family to state the normal blood-pressure range by the second visit. **Table 2** gives the goal-by-goal record. The unmet goal is the one anchored to an absolute clinical target: no pre-session systolic reading fell below 140 mmHg, the lowest being 143 mmHg.

Patient-reported outcomes were the most consistent findings in the record. The patient reported feeling comfortable and relaxed after every session, and that her stiff calf muscles felt looser and lighter when she walked. The caregiver reported that the procedure was easy to perform, and by the third visit performed the full protocol unprompted; he had already begun performing it at home from the evening after the first visit. By the third visit the family stated that they would continue using the technique and would attend the puskesmas when unwell, and expressed the intention to take the medication regularly and to reduce salty food. The whole sequence is drawn in **Figure 2**.

No adverse event occurred. No bruising, syncope, dizziness or procedure-related complaint appears anywhere in the record, and no session was shortened or abandoned. The patient reported nuchal pain and tension on the afternoon of the third visit, before that session's massage, which the record attributes to a day of farm labour and a salted-fish meal; it is reported here as a symptom preceding the intervention. All temperatures remained afebrile; heart rate moved from 81 to 78 beats per minute and respiratory rate from 24 to 22 breaths per minute across the period.

3.7. Sensitivity analyses and quantified sources of variation

Table 7 sets out each source of variation that bears on the haemodynamic result, with a quantity attached to it. Sequential readings taken within one sitting settle by a measurable amount with no intervention: in the randomised rest-period trial the reduction between an initial and a later reading was of the order of several millimetres of mercury systolic and a smaller amount diastolic,55 and the observed acute changes of -7.0 and -3.0 mmHg lie inside that envelope; the 30-minute session also delivered 30 minutes of seated or semi-recumbent rest, which is itself a blood-pressure-lowering exposure and is not separable from the massage in this design. Terminal-digit preference was present: pooled, 8 of the 12 intervention readings end in 0 or 5 (66.7% against 20% expected; exact one-sided binomial p = 0.0006), and the split by measure is systolic 3 of 6 (p = 0.099) against diastolic 5 of 6 (p = 0.0016), consistent with the rounding behaviour documented for manual auscultatory measurement.56,57 Regression to the mean could not be estimated from three observations: only three values of the pre-value–change correlation are attainable (0.415, 0.581, 0.995), the observed value is the middle one at an exact permutation p of 0.667, and in any case correlating a pre-value with its own change is not a valid probe because the pre-value enters both variables with opposite sign.

Table 7. Sensitivity analyses and quantified sources of variation bearing on the haemodynamic result.

Source of variation	Why it applies to this design	Quantification in these data	Consequence for interpretation
Home massage between supervised sessions	The caregiver performed the massage at home from the evening after visit 1, so the intervals between visits contained an additional, unmeasured dose	Supervised dose 30 min × 3 sessions; home dose neither timed nor counted	The between-session component describes what happened between visits, not the decay of a single treatment; carry-over is not estimable from this design
Within-visit settling and 30 minutes of rest	Both readings of a pair are taken in the same sitting, separated by a 30-minute intervention performed seated or semi-recumbent	Published envelope for sequential readings is 2–10 mmHg systolic and 1–5 mmHg diastolic; observed acute change -7.0 and -3.0 mmHg, inside that envelope. The envelope is calibrated for a 1–2 minute gap rather than a 30-minute one	The acute effect is not separable from the measurement procedure and from rest
Terminal-digit preference	Manual auscultatory measurement rounds to multiples of five	Pooled 8/12 readings (66.7%; exact p = 0.0006). Split: systolic 3/6 (p = 0.099); diastolic 5/6 (p = 0.0016)	Rounding alone gives a between-session sum a standard deviation of ±3.54 mmHg, concentrated in diastolic pressure
Regression to the mean	The day-3 session followed an elevated reading after farm labour and a salted-fish meal	Only three values of the pre-value–change correlation are attainable at n = 3 (0.415, 0.581, 0.995); the observed 0.581 is the middle one, exact permutation p = 0.667. The correlation is in any case not a valid probe, the pre-value entering both variables with opposite sign	Not estimable from these data

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Source of variation	Why it applies to this design	Quantification in these data	Consequence for interpretation
Design tier	1 baseline and 3 intervention observations of the primary outcome, in a single pre-post sequence	Single-case design standards require 5 data points per phase to meet standards without reservations and 3 with reservations, and 3 demonstrations of effect; this design supplies 1	The haemodynamic findings are hypothesis-generating
Combined intervention	Massage and structured education were delivered together at every visit	No session contained one component without the other; medication and dietary changes were recorded as intentions stated on the final day	No change can be attributed to either component alone
Detection floor	Three paired observations bound how small a probability the design can return	Two-sided floor 0.25 for systolic and 0.50 for diastolic pressure	Non-significant haemodynamic results are uninformative rather than negative
Single observer, no fidelity instrument	The student who delivered the intervention also measured every outcome and judged caregiver independence	No fidelity checklist, acceptability instrument or second rater for the nursing diagnoses was used	Outcome ascertainment was unblinded
Single household, purposive selection	One family was recruited from the puskesmas hypertension register	n = 1 household, 2 members, 1 index patient, 3 sessions	No generalisation is offered; the implications in Section 4.6 are hypotheses for testing

Each quantification is computed from the case data or against an explicitly cited published benchmark.

Two further features of the design are quantified in the same table. Against single-case intervention design standards, the record provides 1 baseline and 3 intervention observations of the primary outcome, where 5 per phase are required to meet the standards without reservations and 3 to meet them with reservations, and it supplies 1 of the 3 demonstrations of effect the standards require.[53] And because the caregiver performed the massage at home from the evening after the first visit, the between-session intervals contained an unmeasured additional dose, so the between-session component reported in Section 3.4 describes what happened between supervised visits rather than the decay of a single treatment.

4. Discussion

This study followed one rural South Kalimantan household through a complete nursing process for uncontrolled essential hypertension and analysed the resulting record with exact, distribution-free methods. Three findings stand out. Blood pressure fell inside every massage session, by a mean of 7.0 mmHg systolic and 3.0 mmHg diastolic, a magnitude consistent with the published acute effect of foot massage; the direction was uniform, and every exact test returned the smallest probability the design admits. Family hypertension knowledge rose from 20% to 100% with an exact permutation p of 0.0009, the study's only conventional significance. And the caregiver acquired the intervention within a single supervised handover, performing it at home from the evening after the first visit and unprompted by the third.

4.1. The acute response in the context of the published evidence

The acute reductions observed here sit inside the range reported for this class of intervention. The umbrella review of reflexology for blood-pressure control finds consistent short-term reductions across syntheses,[16] and the meta-analysis in cardiovascular patients reports significant post-intervention falls in systolic and diastolic pressure and in heart rate.[17] The randomised trial of foot massage in Indonesian older adults reported reductions of comparable size,[19] as did the trial of foot massage with aromatherapy in essential hypertension[21] and the three-arm trial of self-administered foot massage and reflexology.[18] A mean of 7.0 mmHg systolic and 3.0 mmHg diastolic (**Table 3**, **Table 4**) is therefore an unremarkable result in the best sense: it reproduces, in one household and under ordinary field conditions, what controlled trials report. One difference in estimand should be kept in view. Those meta-analyses pool between-group differences from controlled trials, whereas the present value is a within-subject pre-post change with no control condition, and an uncontrolled pre-post change also contains measurement settling, rest and time effects that a between-group comparison removes.[55]

The mechanism most consistent with a short-lived response is autonomic and vascular. The randomised trial of Thai foot massage documented an immediate rise in renal blood flow, a fall in psychological stress and a parasympathetic shift in heart-rate variability in community-dwelling older adults,[24] and mechanistic synthesis of other non-pharmacological blood-pressure interventions identifies vascular function and autonomic modulation as the mediating pathways.[25] The present study could not probe that mechanism, because heart rate was recorded once per contact rather than before and after each session. The clinical meaning of the acute change should also be stated carefully. A sustained 5 mmHg systolic reduction is associated with roughly a ten per cent reduction in major cardiovascular events,[54] but that estimate comes from sustained pharmacological lowering, and the value is used in this article as a measurement threshold rather than as a claim about cardiovascular risk.

4.2. Interpreting the partition of the record

Reporting the record in partitioned form is the methodological contribution of this article, and it is straightforward to apply. Every study of this kind already holds the readings required: a pre- and a post-session value at each visit is enough to state how much of the total change occurred inside treatment sessions. Here -21 of the -20 mmHg systolic change occurred within sessions (**Table 5**, **Figure 4**a). Presenting the figure that way distinguishes an acute response from a durable one without requiring any additional measurement, and it makes the limits of a short series explicit rather than leaving them to be inferred from a single net value.[52]

What the partition does not do is estimate carry-over in this design, and three considerations explain why. The systolic and diastolic between-session components do not differ from one another when tested (p = 1.000); the direction reverses when the third transition is removed (**Figure 4**b); and the observed sums lie close to the standard deviation of 3.54 mmHg that terminal-digit rounding alone imparts to a sum of six readings. Most importantly, the between-session intervals were not treatment-free: the caregiver was performing the massage at home. That is a favourable finding for the intervention — the handover worked — and simultaneously the reason this design

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cannot separate the decay of one session from the effect of the next. Estimating carry-over requires a washout interval, an explicit instruction about home practice, home blood-pressure monitoring, and a longer series.[61]

4.3. The knowledge outcome

The education component produced the study's only conventionally significant result, and its magnitude matches the literature closely. Structured education reliably raises hypertension knowledge and lifestyle practice,[29] leaflet-supported education has repeatedly moved Indonesian patients from the Poor to the Good band over a comparable number of sessions,[30,31] and interactive delivery outperforms self-directed reading.[32] The design also has more statistical resolution here than anywhere else in the study: ten items measured on three occasions generate an exact permutation reference set of 6,561 arrangements (**Table 6**), where three paired blood-pressure readings generate eight. Two qualifications belong with the result. Q is at its maximum attainable value under these margins, so the magnitude of the p value reflects the design as much as the effect; and the permutation null treats the ten items as exchangeable blocks, whereas they are ten questions put to one dyad taught from one leaflet, so the result is item-level evidence within a single family rather than evidence of a population effect.

The more important caution is about what knowledge predicts. Knowledge is necessary but not sufficient for behaviour change: pooled data place non-adherence to antihypertensive medication near half of treated patients in comparable populations,[8] and Indonesian survey data show self-care weakest in exactly the domains that require sustained daily action.[9] Approaches that add motivational and routine-building components to information do better,[10,11] as do nurse-led self-management programmes delivered over weeks rather than days.[33,34] The intentions this family expressed on the final day — regular medication, less salty food — are the appropriate target of follow-up rather than an outcome of the rotation.

4.4. The theoretical framework

Orem's self-care deficit nursing theory accounts for the structure of this intervention better than any account of massage physiology, and **Figure 5** sets out the application. The therapeutic self-care demand — blood-pressure control, daily medication, sodium restriction, scheduled review, symptom recognition — exceeded the patient's self-care agency. The nursing response was neither wholly nor partly compensatory: the nurse did not perform the care but developed another person's capacity to perform it, which is the supportive-educative nursing system precisely.[42] The 15-minute handover built into every session is dependent-care agency being constructed in real time, and its outcome was directly observable in this case.[44] Training designed explicitly on the theory improves self-care outcomes in other conditions,[43] and the model has already been applied to family-based hypertension care in Indonesia.[45] No Orem-derived instrument was used here, so self-care agency was described qualitatively from the profile in **Table 1** rather than measured. Family systems nursing supplies the complementary reading, that structured conversation and explicit role negotiation shift household caregiving behaviour more than information delivery does;[38,39,40] the role negotiation in this household was implicit, and making it explicit is a plausible improvement.[41]

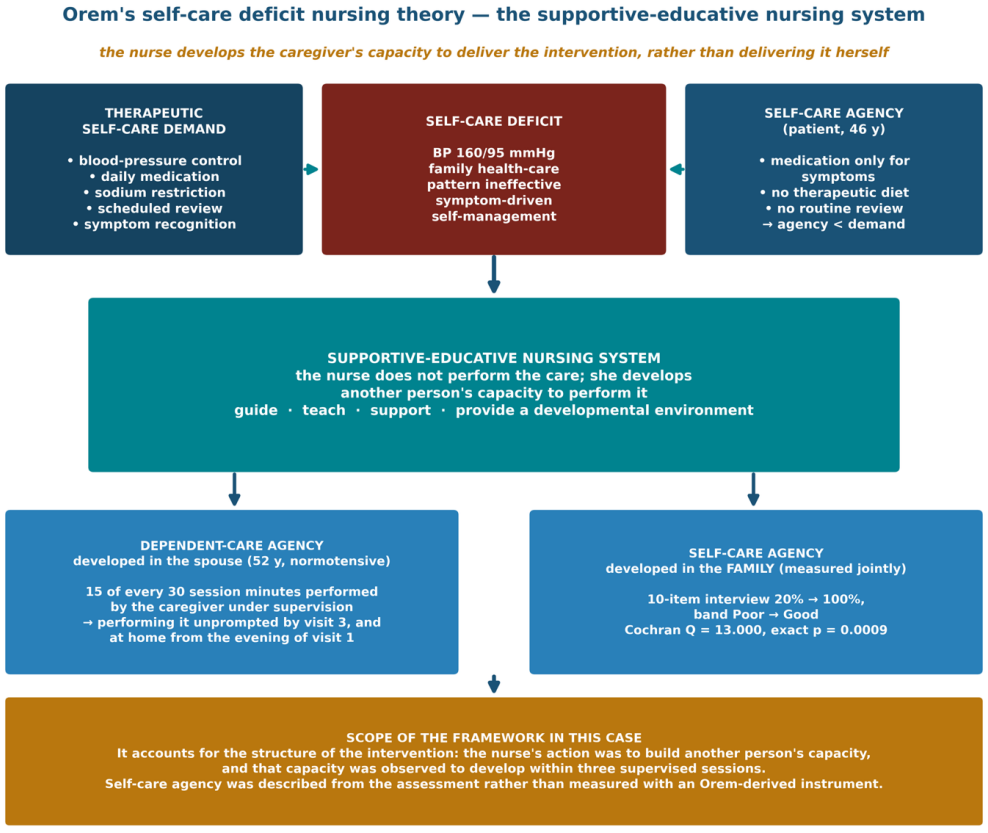

Figure 5. Theoretical framework: Orem's self-care deficit nursing theory, and specifically the supportive-educative nursing system, applied to a caregiver-delivered intervention in a rural Indonesian household. The 15-minute supervised handover at each session is the mechanism by which dependent-care agency is developed.

4.5. Evidence base for the interventions delivered

Each intervention in **Table 2** carries a level of evidence on the hierarchy used in evidence-based nursing practice, which grades the external evidence supporting a practice rather than the findings of this study.[58] Foot massage and reflexology for hypertension rest on Level I evidence for the acute effect, in the form of an umbrella review and meta-analyses of randomised trials;[16,17,27] evidence for persistence beyond the session is weaker, since the trials that measured a later time point generally reported the effect attenuating. Structured education and nurse-led self-management support are also supported at Level I.[29,33] Family involvement promotion is supported by a mixture of Level I synthesis and Level II trials whose duration was weeks rather than days.[35,36,37] Reading the package this way makes an otherwise hidden asymmetry visible: the component with the better evidence for durable benefit is the education, while the component that occupies most of the session time is the massage.

4.6. Implications for practice and research

Three implications follow, each stated as a hypothesis a properly designed study could test. First, the caregiver handover model was feasible in this household: a normotensive 52-year-old farmer with no health training performed a 30-minute protocol unprompted after three supervised sessions, and had begun performing it at home after the first — the transfer of agency that **Figure 5** places at the centre of the framework. Where the Prolanis and Posbindu pathways exist but attendance is limited by farm work, an intervention that lives in the household rather than at the facility is worth testing.[5,6,7] Second, the outcome most consistently observed was symptomatic rather than haemodynamic: comfort, relaxation and looser calf muscles after every session. That is the indication this record supports, and it carries a counselling implication — a patient who has treated her antihypertensive as an analgesic is exactly the patient in whom a therapy giving immediate relief could reinforce that model, so the distinction between symptom relief and pressure control should be made explicit.[8,9] Third, the dietary target is specific and local: salted fish is the dominant sodium source in riverine South Kalimantan households and was named by this patient as preceding the elevated readings for which the record offers an attribution.[12,13,14,15]

For nursing education, the applicable finding is methodological. Student case studies in this genre already hold the readings needed to partition their records, so adopting that partition as a standard analysis — together with an explicit outcome threshold and a statement of the design's detection floor and power — costs nothing and would raise the analytic quality of a large body of Indonesian professional-nursing work.[47,52] Documenting the care in a standardised nursing language, as was done here, makes that comparison possible across cases and settings.[50,51]

4.7. Strengths and limitations

The strengths of this study are the completeness of the primary record — paired readings at every session with no missing data, item-level content named at every visit, and a constant observer, device, arm and position across contacts — the explicit statement of every threshold and attainment criterion, and the use of exact inference with the design's own detection floor and power computed and reported alongside each result, so that a non-significant outcome can be read for what it is.

The limitations follow from the design, and are quantified in **Table 7** rather than merely listed. This is a pre-post series in one household with a single prior observation: it meets neither tier of the single-case intervention design standards and supplies one rather than three demonstrations of effect.[53] There was no control condition, no withdrawal phase and no blinding, and the student who delivered the intervention measured every outcome. The acute change cannot be separated from within-visit settling or from 30 minutes of rest.[55] Blood pressure was recorded as a single reading at each occasion rather than the average of two or three, and shows terminal-digit preference concentrated in the diastolic values.[56,57] The between-session intervals contained unmeasured home massage, so carry-over is not estimable. The 10-item knowledge instrument was constructed locally, has no published reliability evidence, and was administered after each teaching session, so no pre-education measurement exists; its item-level detail supports two readings of the second visit, one of which changes attainment of one goal. Both nursing diagnoses were formulated by a single assessor without a second rater. Follow-up ended with the rotation, so persistence of the caregiver's practice, of the knowledge gain and of any pressure change is unknown. Finally, this is one purposively selected household: no claim of generalisability is made, and the resemblance between this household's clinical picture and the documented national pattern is offered as context rather than as evidence of representativeness.[1,3,4]

4.8. Recommendations for future research

Four recommendations follow directly. First, power the design rather than merely lengthen it: six paired sessions is the point at which a two-sided probability below 0.05 becomes attainable, not the point at which the design is adequate, and eighty per cent power requires about 12 to 23 sessions depending on the per-session response probability assumed. Second, build in a washout: at least one measurement occasion with no massage, together with an explicit instruction about home practice, without which carry-over cannot be estimated. Third, measure what the mechanism predicts: paired heart rate or heart-rate variability across each session,[24] home blood-pressure monitoring rather than one office reading per day,[61] and averaged rather than single readings.[55] Fourth, separate the components: massage and education were delivered together at every visit here, and a multiple-baseline design across households in the same catchment, staggering the two components, would identify which of them carries the effect.[35,53] A validated Indonesian hypertension-knowledge instrument with published reliability, administered before as well as after teaching, would strengthen the one outcome this study did establish.[2,26,28]

5. Conclusion

In this observational analytic case study of one rural South Kalimantan household, caregiver-delivered foot massage combined with structured family education was feasible, acceptable and free of adverse events, and was accompanied by a within-session fall of 7.0 mmHg systolic and 3.0 mmHg diastolic at every session — a magnitude consistent with the published acute effect of this intervention, although at three paired observations every exact test returned the smallest probability the design admits (0.25 systolic, 0.50 diastolic). Partitioning the record showed that -21 of the -20 mmHg net systolic change occurred inside treatment sessions; the between-session component could not be interpreted as decay,

because the caregiver was performing the massage at home. Family hypertension knowledge rose from 20% to 100% (exact permutation p = 0.0009), crossing from the Poor to the Good band, and 4 of 5 goal criteria were attained. For evidence-based nursing practice the defensible position is that foot massage is a caregiver-deliverable adjunct with Level I support for an acute effect and consistent patient-reported comfort, and that the durable expectation belongs with the education and self-management components. For professional nursing education, the practical recommendation is that student case studies partition their blood-pressure records, state their detection limits, and be powered rather than merely long enough for significance to be attainable.

6. Declarations

Statement on the Use of Artificial Intelligence

Use of generative artificial intelligence: None declared.

Author Contribution Statement

FZ conceived the study, delivered the nursing care, collected the data, performed the analysis and drafted the manuscript. R supervised the clinical work and the study design and critically revised the manuscript. RMM supervised the analysis and the interpretation and critically revised the manuscript.

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This study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of Interest / Competing Interests

The authors declare that they have no competing interests.

Data Availability Statement

The de-identified observations analysed in this study, the analysis script that re-derives every reported value, the reference registry, the verification harness and the completed CARE checklist accompany this submission as supplementary files and are also available from the corresponding author.

Ethical approval and consent to participate

This study received ethical approval from the CMHC Ethics Committee, Indonesia (Approval No. CMHC/EC/2024/0186). Written informed consent was obtained from the patient and from her family caregiver prior to data collection, including consent for the publication of anonymised clinical details. The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Written informed consent for the publication of anonymised clinical information was obtained from the patient and from her family caregiver. Because a single household in a named catchment is intrinsically identifiable, the village sub-unit, the case's rank in the local disease register and the cause of the couple's bereavement have been withheld, and no photograph, genogram or reproduced document appears in this article.

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Author Approval

All authors have reviewed and approved the final version of the manuscript. The authors agree to be accountable for the work.

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