

RISK FACTORS FOR FOOT ULCERATION IN ADULTS WITH ESRD ON DIALYSIS

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ADVANCING HEALING HORIZONS:
TOWARDS THE CUTTING EDGE IN WOUND CARE



Declaration of Financial Interests or Relationships

Speaker Name: Dr Michelle Kaminski

I have no financial interest or relationship(s) to disclose.

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WHAT IS END-STAGE RENAL DISEASE (ESRD)?

- Chronic medical condition - significant loss of kidney function
- Dialysis or kidney transplant required for survival
- Dialysis removes metabolic waste products, water and toxic substances
- Leading causes of ESRD in Australia:
 - Diabetes mellitus (35%)
 - Nephritis (19%)
 - Hypertension (14%)



BACKGROUND

- High prevalence of foot ulceration (14.4%) and amputation (5.9%)
- Detrimental impact and financial burden
- Poor foot salvage and prognosis
- **One** and **five** year survival rates following a lower extremity amputation:
 - Haemodialysis (50.8%, 17.2%)
 - Moderate to severe CKD (76.6%, 40.9%)
 - Mild or no CKD (85.6%, 60.3%)

RESEARCH PROBLEM

- There is limited high-quality evidence for the risk factors for foot ulceration
- Large multi-centre prospective cohort studies are needed

STUDY AIM

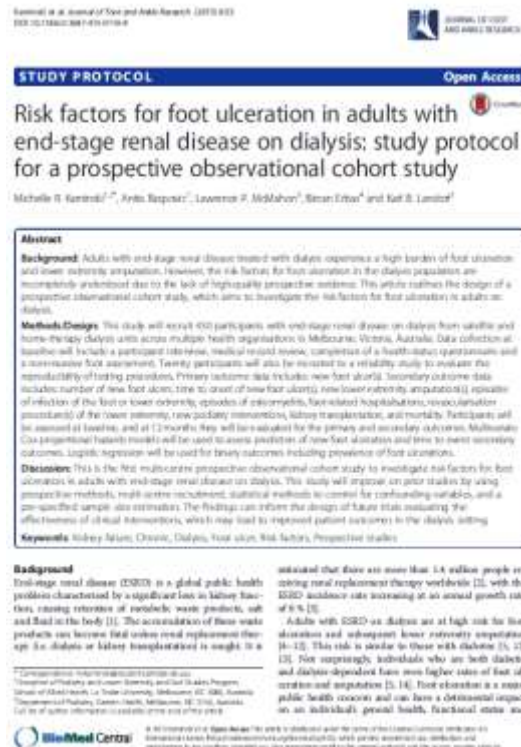
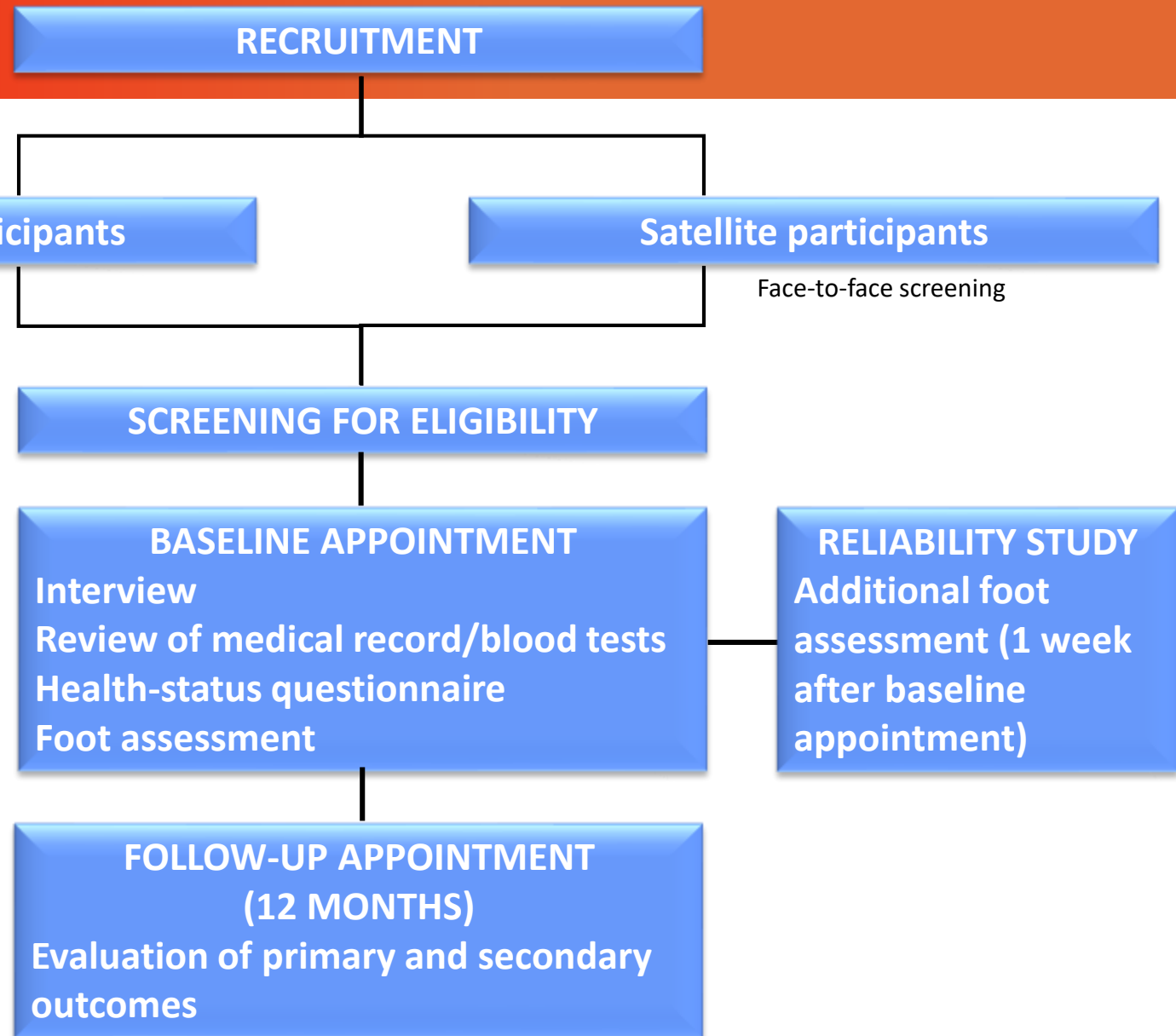
- To investigate the risk factors for foot ulceration in adults with ESRD on dialysis

METHODS

- Multi-centre prospective observational cohort study
- 450 participants recruited

Inclusion criteria	Exclusion criteria
ESRD and clinically stable on dialysis (haemodialysis or peritoneal dialysis)	Insufficient English skills to provide informed consent or follow instructions during the project
≥18 years of age	Unwilling or unable to give informed consent to participate
Cognitively aware (i.e. to provide informed consent)	

STUDY FLOW



DATA COLLECTION

- Participant characteristics
- Dialysis-related variables
- Comorbidities
- Blood results
- Foot complications
- Foot-health care behaviours
- Health status questionnaire
- Foot examination



NEUROLOGICAL ASSESSMENT

- Protective sensation (Semmes-Weinstein 5.07/10g monofilament)
- Vibration perception threshold (Neurothesiometer)



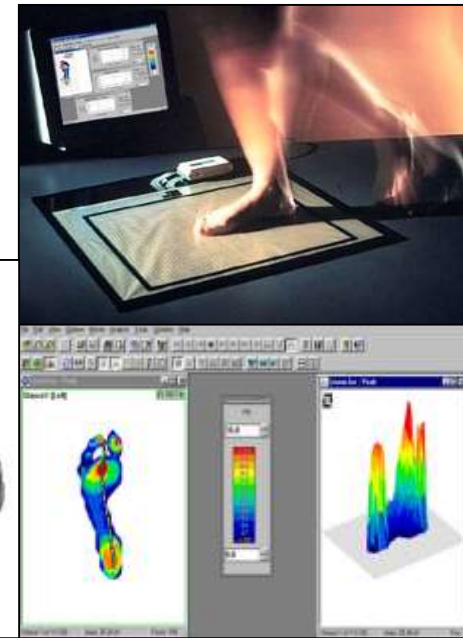
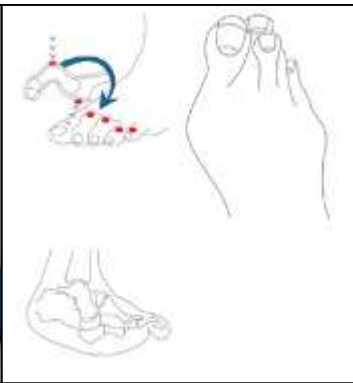
ARTERIAL ASSESSMENT

- Palpation of pedal pulses
- Ankle-brachial pressure index
- Toe-brachial pressure index (Systoe® automated system)



BIOMECHANICAL/FOOTWEAR ASSESSMENT

- 1st metatarsophalangeal joint (MTPJ) range of motion
- Peak plantar pressures (TekScan® MatScan system)
- Foot deformity
- Footwear (fit, type, condition)



DERMATOLOGICAL ASSESSMENT

Skin and nail pathology

- Corns/calluses
- Uraemic pruritus (itchy skin)
- Xerosis (dry skin)
- Calciphylaxis
- Onychomycosis (fungal nail)
- Onychocryptosis (ingrown nail)
- Onychauxis (thickened nail)



Calciphylaxis

STUDY OUTCOMES

Primary outcome	Secondary outcomes
<ul style="list-style-type: none">• Foot ulceration	<ul style="list-style-type: none">• Number and time to onset of foot ulceration• Lower extremity amputations• Episodes of infection• Foot-related hospitalisations• Revascularisation procedures• Kidney transplantation• Mortality

STATISTICAL ANALYSIS

- Cox proportional hazards analysis
- Multinomial logistic regression
- Risk estimates presented as HR, RR, OR (depending on model) and 95% CIs

RESULTS: BASELINE

Participant characteristics	Total (n = 450)
Mean age \pm SD, <i>years</i>	67.5 \pm 13.2
Male, <i>n(%)</i>	64.7
Smoker, <i>n(%)</i>	12.0
Mean body mass index \pm SD, <i>kg/m²</i>	28.2 \pm 6.6
Living alone, <i>n(%)</i>	16.7
Haemodialysis, <i>n(%)</i>	94.0
Peritoneal dialysis, <i>n(%)</i>	6.0
Median dialysis duration (IQR), <i>months</i>	37 (17 to 70)
Diabetes mellitus, <i>n(%)</i>	50.2
Mean diabetes duration \pm SD, <i>months</i>	256 \pm 153

Foot examination	Total (n = 450)
Peripheral neuropathy, <i>n(%)</i>	50.7
Peripheral arterial disease, <i>n(%)</i>	52.4
Arterial calcification, <i>n(%)</i>	40.9
Limited 1 st MTPJ range of motion, <i>n(%)</i>	93.6
Foot deformity, <i>n(%)</i>	75.8
Skin pathology, <i>n(%)</i>	87.8
Nail pathology, <i>n(%)</i>	70.9
Inappropriate/ill-fitting footwear, <i>n(%)</i>	66.0
Poor foot-health care behaviours, <i>n(%)</i>	30.2
Podiatry attendance (last 12 months), <i>n(%)</i>	49.6

RESULTS: PRIMARY OUTCOME

FOOT ULCERATION

- 81 participants (18%)
- 211 foot ulcers (200 new, 11 reoccurring)
- Majority located on the toes (61%)
- Time to onset 164 ± 127 days
- Annual incidence 122 per 1,000 person-years

RESULTS: SECONDARY OUTCOMES

LOWER EXTREMITY AMPUTATION

- 12 participants (2.7%)
- 20 amputations (18 minor, 2 major)
- Reason for amputation: PAD/gangrene (45%), infected foot ulcer (40%), osteomyelitis (15%)

RESULTS: SECONDARY OUTCOMES cont...

EPISODES OF INFECTION

- 96 participants (21.3%), 182 episodes
- Common infections: cellulitis (10.9%), local wound infection (8.2%), osteomyelitis (5.3%)

REVASCULARISATION PROCEDURES

- 24 participants (5.3%), 42 procedures
- 81% angioplasties

RESULTS: SECONDARY OUTCOMES cont...

FOOT-RELATED HOSPITAL ADMISSIONS

- 42 participants (9.3%)
- 74 admissions
- Length of stay 25 ± 23 days
- Admitted due to infected foot ulcer (28.4%)

KIDNEY TRANSPLANT

- 30 participants (6.7%)

RESULTS: SECONDARY OUTCOMES cont...

ALL-CAUSE MORTALITY

- 52 participants (11.6%)
- Common causes: myocardial infarction (23.1%), withdrawal from dialysis (15.4%), pneumonia (15.4%)

FOOT-RELATED MORTALITY (n = 6)

- Sepsis secondary to infected foot ulcer (n = 5)
- Due to complications of PAD (n = 1)

RESULTS: RISK FACTORS

Risk factor	Hazard ratio (95% CI)	<i>P</i>-value
Peripheral neuropathy	3.02 (1.48 to 6.15)	0.002*
Previous foot ulceration	2.86 (1.53 to 5.34)	0.001*
Cerebrovascular disease	1.82 (0.98 to 3.36)	0.057

RESULTS: RISK FACTORS

Category	N	Risk factor	Relative Risk (95% CI)	P-value
Never ulcerated	369	Reference Category		
New foot ulceration (<u>no</u> past/baseline ulcer)	27	Diabetes mellitus	0.68 (0.28, 1.63)	0.388
		Peripheral neuropathy	2.66 (1.04, 6.82)	0.040*
		Peripheral arterial disease	0.58 (0.24, 1.41)	0.229
		Cerebrovascular disease	1.37 (0.54, 3.50)	0.511
		Nail pathology	3.85 (1.08, 13.75)	0.038*
New foot ulceration (past/baseline ulcer)	54	Diabetes mellitus	1.84 (0.75, 4.48)	0.180
		Peripheral neuropathy	11.23 (3.16, 39.87)	<0.001**
		Peripheral arterial disease	7.15 (2.24, 22.82)	0.001**
		Cerebrovascular disease	2.08 (1.04, 4.16)	0.037*
		Nail pathology	1.02 (0.43, 2.45)	0.953

DISCUSSION

- **Peripheral neuropathy** and **previous foot ulceration** are major risk factors for foot ulceration
- **Nail pathology** and **neuropathy** are risk factors in those *without* history of ulceration
- **Neuropathy, peripheral arterial disease** and **cerebrovascular disease** are risk factors in those *with* history of ulceration
- Diabetes is not a primary or significant risk factor, as other comorbidities (such as neuropathy and peripheral arterial disease) have stronger associations with ulceration

CLINICAL IMPLICATIONS

- First study to identify longitudinal risk estimates for foot ulceration in a large dialysis cohort
- Clearer understanding of risk factors and identification of those at the highest risk
- Highlights a clear need for foot care provision to dialysis patients
- Risk factors identified may help to reduce the incidence of foot ulceration and its associated complications

FUTURE RESEARCH

- Direct health care prioritisation - develop prevention and early treatment programs
- Inform the design of randomised clinical trials that target the risk factors for ulceration in the dialysis population

CONCLUSION

- There is a high prevalence and incidence of foot ulceration
- Peripheral neuropathy and previous foot ulceration are major risk factors
- Risk factors differ between those with and without a history of ulceration
- Diabetes is not a significant risk factor on its own
- These findings should help reduce the incidence of foot ulceration and its associated complications

THANK YOU



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RELIABILITY STUDY

- 20 participants recruited
- Foot assessment on 2 separate occasions (one week apart)
- Intra-examiner reliability for the monofilament, neurothesiometer, palpation of pedal pulses, ABPI, TBPI, 1st MTPJ ROM tests

RESULTS

- ICCs ranged between 0.87 and 0.99
- All weighted kappa values equalled 1.00 (absolute % agreement ranged from 95 to 100%)