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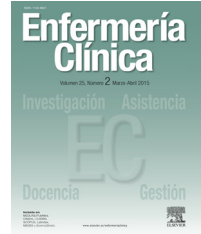
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## The effect of oral hydrotherapy on risk reduction of diabetic feet ulcer among people with type-2 diabetes mellitus

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### KEYWORDS

Oral hydrotherapy;  
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**Abstract** Diabetic feet ulcer is four times more likely to be found in patients who suffer from diabetes mellitus than in those who don't. Diabetic feet ulcer is one of chronic complications of diabetes mellitus which causes defects even deaths. Diabetes mellitus is one of the ten most frequent diseases in Indonesia. According to *Riskesmas (Riset Kesehatan Dasar – Basic Health Research)*, the increment number of patients with diabetes mellitus from 2007 up to 2013 is 330,512.<sup>1</sup> The research is aimed to find out the effect of oral hydrotherapy on risk reduction of diabetic feet ulcer in patients with type-2 diabetes mellitus. The research was done by applying quasi-experimental design (pre-test and post-test design with control group). By total population sampling, there were 68 respondents who participated. About 34 of the respondents were in experimental group at Dr. Soediran Mangun Sumarso of Wonogiri, and 34 respondents were patients who had check-ups at RS PKU Muhammadiyah of Surakarta. The research result shows that oral hydrotherapy can minimize risk reduction of diabetic feet ulcer in patients with type-2 diabetes mellitus significantly with  $p$ -value of 0.000 ( $\alpha = 0.005$ ).

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### Introduction

Diabetic feet ulcer is an infection, ulceration, or destruction of inner connective tissue related to neuropathy and peripheral vascular disease in lower limbs. According to May,<sup>1</sup> patients who suffer from diabetes mellitus are four times more likely to have peripheral arterial disease compared to those who do not. PAD is a common macrovascular

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32 complication in T2DM patients, which not only may con- 91  
33 tribute for initiation and aggravation of diabetic foot ulcer 92  
34 but also is an efficient predictor of cardiovascular mortality 93  
35 and morbidity.<sup>2</sup>

36 WHO estimated that three hundred sixty six million peo- 94  
37 ple have DM in 2011; half of these (183 million people) are 95  
38 undiagnosed. The number of people with DM worldwide is 96  
39 increasing and by 2030 this will have risen to 552 million.<sup>3</sup> 97  
40 According to Basic Health Research in 2007, deaths caused 98  
41 by diabetes mellitus in the 45-54-year age group in cities 99  
42 ranked second at the percentage of 14.7%, while in villages, 100  
43 it ranked sixth at the percentage of 5.8%.<sup>4</sup> 101

44 Diabetic feet ulcer is one of the most serious 102  
45 complications, and for people with diabetes mellitus, it can 103  
46 lead to defects. People with diabetes account for more 104  
47 than 40% of hospitalizations for major amputations and 105  
48 73% of emergency room admissions for minor amputations.<sup>5</sup> 106  
49 According to Navarro-Peternella et al.<sup>6</sup> women have higher 107  
50 risk six times to have diabetic feet ulcer than man. 108

51 Furthermore, Navarro-Peternella et al.<sup>6</sup> stated that the 109  
52 older the age of the people with diabetes mellitus, the 110  
53 higher the risk to have diabetic feet ulcer since old people 111  
54 have less body movement, worse eyesight, and other health 112  
55 problems. According to Martínez-Castelao et al.,<sup>7</sup> 10-25% 113  
56 of diabetes mellitus cases lead to diabetic feet ulcer.<sup>8</sup> This 114  
57 indicates that 58% of 100 patients suffering from diabetes 115  
58 mellitus with diabetic feet ulcer have suffered from diabetes 116  
59 mellitus for more than 10 years.

60 Management of diabetes can be conducted pharmaco- 117  
61 logically by glucose and/or insulin control treatment, or 118  
62 non-pharmacologically such as healthy lifestyle modifica- 119  
63 tion, activity and energy management, and complementary 120  
64 therapy. One example of complementary therapies which is 121  
65 usually used is oral hydrotherapy. It is done by drinking 1.5 l 122  
66 of warm water every morning soon after getting up, or by 123  
67 drinking 8 glasses of water at the least every day. 124

68 Hydrotherapy is the cheapest health therapy and it has 125  
69 a lot of benefits. According to Daniel and Popkin,<sup>9</sup> drinking 126  
70 water can lessen obesity and fulfill the need of fiber. Water 127  
71 consumption helps the process of detoxification including 128  
72 getting rid of sugar excess in body.<sup>10</sup> Explains that drink- 129  
73 ing water can release chemical substances such as glucose 130  
74 and other substances through kidneys and through the body 131  
75 organ cleaning process. 132

76 Osmotic increase and glucose dilution in plasma can 133  
77 increase peripheral circulation. Guaranteed adequate cir- 134  
78 culation leads to the decrease of peripheral arterial disease 135  
79 (PAD) so that feet ulcer can be prevented as early as possi- 136  
80 ble. PAD check can be done by a measurement using Ankle 137  
81 Brachial Index (ABI). Study was conducted by Xu et al.<sup>11</sup> show 138  
82 that the ABI value = 0.9 can be a simple diagnosing instru- 139  
83 ment, can be used to identify peripheral arterial disease 140  
84 with severe stenosis, and can be a substitute instrument to 141  
85 do another non-invasive check-up clinically.

## 86 Methods

87 The research applies quasi-experimental design by pre and 142  
88 post-test with control group. The 68 samples were taken by 143  
89 using totally sampling method. 34 respondents at RSUD dr. 144  
90 Soediran Mangoen Sumarso of Wonogiri got pharmacologi-

cal treatment therapy and oral hydrotherapy. The other 34 91  
respondents at RS PKU Muhammadiyah of Surakarta only got 92  
pharmacological therapy. 93

## 94 Results

### 95 Univariate analysis

96 By univariate analysis, respondent characteristics based on 97  
age, sex and Ankle Brachial Index can be identified.

### 98 Homogeneity test

#### 99 Age

100 The average age of the respondents in the control group 101  
is 56.32 with the standard deviation of 7.36. The youngest 102  
age is 40 years old and the oldest is 70 years old. In the 103  
intervention group, the average age of the respondents is 104  
52.41 with the standard deviation of 9.88. The youngest age 105  
is 31 years old and the oldest age is 70 years old. Based on 106  
homogeneity test, it was found that there was parity of the 107  
ages of the respondents with  $p$ -value of 0.069,  $\alpha = 0.05$ , in 108  
both the control group and the intervention group.

#### 109 Sex

110 Among 68 respondents involved in the research, 22 respon- 111  
dents of them are male and the other 46 respondents are 112  
female. There are 9 male respondents (26.5%) in the control 113  
group and 13 male respondents (38.2%) in the interven- 114  
tion group. There are 25 female respondents (73.5%) in the 115  
control group and 21 female respondents (61.80%) in the 116  
intervention group. Sex parity with  $p = 0.26$  and  $\alpha = 0.05$ .

#### 117 Ankle Brachial Index

118 The measurement using Ankle Brachial Index, in the control 119  
group, it was found that the extremity average of the 120  
right legs of the respondents before oral hydrotherapy was 121  
0.86 with the standard deviation of 0.11, and the extrem- 122  
ity average of the left legs of the respondents before oral 123  
hydrotherapy was 0.88 with the standard deviation of 0.10. 124  
After oral hydrotherapy treatment, the extremity average of 125  
the right legs was 1.00 with the standard deviation of 0.10, 126  
and the extremity average of the left legs was 0.99 with the 127  
standard deviation of 0.04.

128 In the intervention group, the extremity average of the 129  
right legs of the respondents was 0.93 with the standard 130  
deviation of 0.07, and the extremity average of the left legs 131  
of the respondents was 0.94 with the standard deviation of 132  
0.07. After the intervention, the extremity average of the 133  
right legs of the respondents in the intervention group was 134  
0.93 with the standard deviation of 0.07, and the extremity 135  
average of the left legs was 0.94 with the standard deviation 136  
of 0.07.

137 **Table 1** shows the result of homogeneity test with one- 138  
way ANOVA (one-way analysis of variance) technique. There 139  
is equal values of ABI of right legs with  $p$ -value of 0.74 and 140  
equal values of ABI of left legs with  $p$ -value of 0.61 and 141  
 $\alpha = 0.05$ .

**Table 1** The equal values of ABI of right legs and left legs in the control group and the intervention group.

Extremity	Group	Mean	Standard deviation	p-value
Right legs	Control	0.86	0.11	0.74
	Intervention	0.93	0.07	
Left legs	Control	0.88	0.10	0.61
	Intervention	0.94	0.07	

**Table 2** Paired t test of ABI value of right legs in the intervention group before and after oral hydrotherapy treatment.

Mean	SD	SE	p-value	N
0.93	0.07	0.01	0.05	34
1.00	0.10	0.02		34

**Table 3** Paired t test of ABI value of left legs in the intervention group before and after oral hydrotherapy treatment.

Mean	SD	SE	p-value	N
0.94	0.07	0.01	0.000	34
0.94	0.04	0.01		34

**Table 4** T-test of ABI value in the control group and the intervention group.

Extremity	Group	Mean	SD	p-value
Right legs	Intervention	1.00	0.10	0.000
	Control	0.86	0.11	
Left legs	Intervention	0.99	0.04	0.000
	Control	0.88	0.99	

### Normality test

On the normality test, it was found that the skewness value of ABI variable of right legs before hydrotherapy was 0.037, with standard error value of 0.403, so that the value of skewness normality was 0.092 (<2). This means the data distribution was normal. On the test of left legs before hydrotherapy, it was found that the skewness value was 0.827, with standard error value of 0.403, so that the value of skewness normality was 2.00 (<2). This means the data distribution was also normal. On the normality test of ABI variable of right legs after hydrotherapy, it was found that the skewness value was 0.614, with standard error value of 0.403, so that the value of skewness normality was 0.092 (<2). This shows the data distribution was normal. On the test of left legs after hydrotherapy, it was found that the skewness value was 0.561, with standard error value of 0.403, so that the value of skewness normality was 1.39 (<2). This also shows normal data distribution.

Based on normality test previously shown, bivariate analysis was done by using paired t test. Table 2 shows there is difference of ABI values of right legs before and after oral hydrotherapy treatment with p-value of 0.005. Table 3 shows there is difference of ABI values of left legs of the respondents before and after oral hydrotherapy treatment with p-value of 0.000. Table 4 shows the increase of mean values

of ABI after the intervention both on right legs (0.14) and left legs (0.11). p-value of right legs is 0.000 and p-value of left legs is 0.000. Thus, it can be concluded that oral hydrotherapy helps in minimizing risk of diabetic feet ulcer.

### Discussion

According to the research result, it was found that oral hydrotherapy helped in minimizing risk of diabetic feet ulcer in patients with type 2 diabetes mellitus with p-value of 0.000 ( $\alpha = 0.005$ ). Oral hydrotherapy helps patients with diabetic feet ulcer in the process of body detoxification, including releasing excess of sugar. The research goes along with MacAulay and Zeuthen<sup>12</sup> who states that body fluid can lead to osmotic increase that can dilute glucose in plasma. When glucose in blood is in normal condition, food supply can be more easily transferred to repair organ with diabetic feet ulcer. According to Ikem et al.,<sup>13</sup> diluting glucose is the best solution for people suffering from diabetes mellitus in lowering blood sugar level.

The research result of study conducted by Daniels and Popkin<sup>14</sup> explains that drinking water can fulfill the need of fiber and fluid in people suffering from diabetes mellitus. The research result also shows that diabetic feet ulcer occurs more in women, which is 67.65% compared to the number of men with diabetic feet ulcer. The result goes along with the research conducted by Chivese et al.<sup>15</sup> and Younis et al.<sup>16</sup> which tells that diabetic feet ulcer occurs more in women.

Aging leads to higher risk of diabetic feet ulcer because body function worsens physiologically. The average age of patients with diabetic feet ulcer in the research is 56.32 in the control group and 52.41 in the intervention group. The research result goes along with the research result of Younis et al., 2018 in which there is significant relation between age and the increasing number of peripheral arterial disease cases in patients with type 2 diabetes mellitus.<sup>17</sup>

### Conclusion

Oral hydrotherapy can minimize the risk of diabetic feet ulcer in patients with type 2 diabetes mellitus. Oral hydrotherapy is done by drinking 1.5 l of boiled water within 2 h every morning (after getting up before rinsing mouth and brushing teeth) for 30 days and the water must be daily consumed, odorless, colorless, and tasteless.

### Conflict of interests

The authors declare no conflict of interest.

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