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Evaluating the Impact of Foot Massage on Pulmonary Function in Patients with Acute Coronary Syndrome

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Abstract

Background: Acute Coronary Syndrome (ACS) is a significant global health concern, affecting millions annually and contributing to high mortality rates. ACS encompasses unstable angina, non-ST-segment-elevation myocardial infarction (NSTEMI), and ST-segment-elevation myocardial infarction (STEMI). Patients with ACS often experience respiratory distress due to increased sympathetic activity, necessitating effective, non-invasive interventions to support pulmonary function.

Objective: This study aims to evaluate the effectiveness of foot massage in improving pulmonary parameters among patients with ACS.

Methods: A quasi-experimental study was conducted at the Karbala Center for Cardiac Diseases and Surgery. A purposive non-probability sample of 60 patients diagnosed with ACS was divided into an intervention group (receiving foot massage) and a control group (receiving standard care). The intervention group underwent a structured four-step foot massage for 5 minutes per foot. Pulmonary parameters, including respiratory rate (RR) and oxygen saturation (SpO_2), were assessed three times: before the intervention, 5 minutes after, and 10 minutes after. Data collection was structured into two parts: demographic and clinical information and pulmonary function assessment using a standardized physiological checklist.

Results: A statistically significant improvement was observed in the pulmonary parameters of the intervention group, with reductions in respiratory rate and increases in oxygen saturation ($p < 0.05$). In contrast, no significant changes were noted in the control group.

Conclusion: The findings suggest that foot massage is an effective complementary intervention for enhancing pulmonary function in patients with ACS. This non-invasive, low-cost approach may improve respiratory outcomes and patient well-being.

What is already known about the topic? Acute Coronary Syndrome (ACS) can impair pulmonary function: Patients with ACS often experience compromised lung function due to factors like chest pain, anxiety, limited mobility, and decreased oxygenation, especially during the acute phase of the illness.

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Introduction

Cardiovascular diseases remain the leading cause of mortality worldwide. According to the World Health Organization (WHO), approximately 17.9 million deaths annually are attributed to cardiovascular diseases, accounting for 31% of global deaths. Indonesia, for instance, records 371 cardiovascular-related deaths per 100,000 people, ranking 32nd in the world for mortality rates from cardiovascular diseases (Setiawan & Rahayu, 2021).

Acute Coronary Syndrome (ACS) is a significant public health burden, particularly in the United States, where it affects over one million patients annually (Sánchez-de-la-Torre et al., 2020). ACS is a life-threatening condition characterized by the disruption of coronary circulation, necessitating immediate medical intervention to prevent fatal outcomes. The American Heart Association estimates that 40.5% of individuals have some form of cardiovascular disease, with 34% of these cases resulting in mortality annually (Alimohammad et al., 2018). ACS, a leading cause of emergency department visits, has a global fatality rate of approximately 25% (Veiskaramian et al., 2021).

The term ACS encompasses unstable angina (UA), non-ST-segment-elevation myocardial infarction (NSTEMI), and ST-segment-elevation myocardial infarction (STEMI)—all of which fall under ischemic heart disease (IHD). While advancements in primary prevention, lifestyle modifications, and medical therapies have contributed to a decline in ACS-related mortality, incidence rates remain concerning. Effective treatments for ACS include reperfusion therapy, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG), particularly when thrombolysis is not feasible (van Oosterhout et al., 2020).

Beyond the physical burden, ACS patients frequently experience heightened psychological distress, including fear of mortality, recurrent myocardial infarction (MI), and uncertainty about their prognosis. These stressors trigger physiological responses, such as the release of catecholamines, which can exacerbate ACS progression by increasing blood pressure, heart rate, respiratory rate, and dyspnea (Bahrami et al., 2017).

Massage therapy has been recognized for its therapeutic benefits, which include inducing relaxation, reducing metabolic activity, stabilizing respiration, and lowering heart rate (Rodrigues, 2018). Among various massage techniques, foot massage has been identified as a non-invasive intervention that positively influences blood pressure, pulse rate, and

respiratory function. It is particularly beneficial for patients with vascular conditions and life-threatening illnesses (Lee et al., 2017). Unlike other forms of massage, foot massage primarily involves gentle manipulation of the soft tissues on the soles of the feet, without focusing on specific reflexology points (Putu et al., 2023).

Study Aim

This study aims to evaluate the effectiveness of foot massage in improving pulmonary parameters (respiratory rate and oxygen saturation) in patients with ACS.

Methods

Study Design and Setting

This quasi-experimental study was conducted at the Karbala Center for Cardiac Diseases and Surgery from December 25, 2023, to May 11, 2024.

Ethical Considerations

The study received ethical approval from the Scientific Research Committee at the Nursing College of Karbala University (Approval Code: uok.con.23.012, Decision No: 2023.11.14). The trial was also registered with the Iranian Registry of Clinical Trials (IRCT) on May 11, 2024 (Registration Reference: IRCT20240124060784N2, Trial ID: 76642, Membership No: 60784).

Inclusion Criteria

- Patients diagnosed with ACS and confirmed through surgical assessment.
- Iraqi nationals.
- Aged 18 years or older.

Exclusion Criteria

- Patients with foot-related conditions (e.g., calluses, corns, fungal infections, scars, diabetic foot, or known neuropathy).
- Patients with lower limb amputations.

Study Sample

A total of 60 ACS patients were selected using a non-probability purposive sampling technique. Participants were divided into two groups:

1. Intervention Group (n = 30) – Received a structured four-step foot massage (5 minutes per foot).

2. Control Group (n = 30) – Received standard medical care only (without foot massage).

Data Collection and Pulmonary Parameter Assessment

Pulmonary parameters, including respiratory rate (RR) and oxygen saturation (SpO_2), were measured at three time points:

- Baseline (before intervention)
- 5 minutes after intervention
- 10 minutes after intervention

Demographic and clinical data were also collected.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics (Version 26). The following statistical tests were applied:

- Descriptive statistics (frequency, percentage, and mean scores).
- One-way ANOVA and independent t-tests to compare groups.
- A p-value of <0.05 was considered statistically significant.

Results

The demographic analysis of the study participants revealed that the majority of individuals were aged 50-69 years, accounting for 60% in the intervention group and 63.3% in the control group. The gender distribution showed a higher prevalence of males, with 76.7% in the intervention group and 73.3% in the control group. In terms of marital status, most participants were married (83.3% in the intervention group and 80% in the control group). Regarding education levels, 40% of the intervention group and 36.7% of the control group had no formal education. Occupationally, 40% of the intervention group and 30% of the control group were self-employed. Additionally, approximately 50% of participants in both groups were current smokers.

The clinical characteristics showed that a majority of patients were overweight, with 56.7% in the intervention group and 66.7% in the control group. Comorbidities such as hypertension and diabetes mellitus (HTN & DM) were present in 43.3% of the intervention group and 63.3% of the control group. Additionally, 36.7% of the intervention group and 60% of the control group were taking antihypertensive and anti-diabetic medications.

The assessment of pulmonary parameters revealed notable differences between the study and control groups. Respiratory rate (RR) significantly improved in the intervention group ($p = 0.030$), while no significant change was observed in the control group ($p = 0.482$). Similarly, oxygen saturation (SpO_2) showed a highly significant increase in the intervention group ($p = 0.001$), whereas no significant change was noted in the control group ($p = 0.077$). Figures 5 and 6 visually depict the changes in RR and SpO_2 across the three measurement points (before intervention, 5 minutes after, and 10 minutes after the foot massage), further supporting the effectiveness of the intervention in enhancing pulmonary function.

Table 1. Distribution of participants according to their socio-demographic characteristics:

Socio-Demographic Characteristics		Control Group		Study Group		P-Value
		f.	%	f.	%	(Sig)
Age	30-49	3	10.0	7	23.3	
	50-69	19	63.3	18	60.0	
(Per Years)	70-89	8	26.7	5	16.7	**.822**
Mean ± SD	**Total**	**30**	**100.0**	**30**	**100.0**	**(NS)**
59. 9 ± 11.7						
Sex	Male	22	73.3	23	76.7	**.770**
	Female	8	26.7	7	23.3	
	Total	**30**	**100.0**	30	100.0	**(NS)**
Marital Status	single	1	3.3	0	0	
	married	24	80.0	25	83.3	**.846**
	Separate	2	6.7	2	6.7	
	Widower	3	10.0	3	10.0	**(NS)**
	Total	**30**	**100.0**	30	100.0	
Educational Level	No reading or writing	11	36.7	12	40.0	
	Reading and writing	2	6.7	1	3.3	
	Primary level	7	23.3	7	23.3	**.873**
	Secondary level	6	20.0	6	20.0	**(NS)**
	Institute	4	13.3	3	10.0	
	Collage and above	0	0	1	3.3	
	Total	**30**	**100**	**30**	**100.0**	
Occupation Status	retired	6	20.0	4	13.3	**.323**
	Housewife	9	30.0	6	20.0	
	government employee	2	6.7	5	16.7	**(NS)**

	idle	4	13.3	3	10.0	
	free business	9	30.0	12	40.0	
	Total	**30**	**100.0**	**30**	**100.0**	
Smoking Status	never	12	40.0	7	23.3	**.387**
	previously	4	13.3	8	26.7	
	currently	14	46.7	15	50.0	**(NS)**
	Total	**30**	**100.0**	**30**	**100.0**	

Table 2. Distribution of participants according to their clinical data:

Clinical data		**Control Group**		**Study Group**		**P-Value**
		f.	**%**	**f.**	**%**	**(Sig)**
Body mass index	Normal	7	23.3	10	33.3	
	Over Weight	20	66.7	17	56.7	
	Obesity Class I	3	10.0	2	6.7	
	Obesity Class II	0	0	1	3.3	**.855**
Mean ± SD	**Total**	**30**	**100.0**	**30**	**100.0**	**(NS)**
27.31 ± 5.33						
chronic diseases	None	3	10.0	1	3.3	
	HTN	5	16.7	10	33.3	**.381**
	DM	3	10.0	6	20.0	
	HTN And DM	19	63.3	13	43.3	**(NS)**
	Total	**30**	**100.0**	**30**	**100.0**	
Medications used for chronic diseases	None	3	10.0	2	6.6	
	Antihypertensive Drugs	5	16.7	11	36.7	
	Anti-Diabetic Drugs	4	13.3	6	20.0	**.178**
	Antihypertensive & Anti Diabetic Drugs	18	60.0	11	36.7	**(NS)**
	Total	**30**	**100.0**	**30**	**100.0**	

Table 3. Comparison between the mean of the readings of pulmonary parameters, for the study group and control group:

Variables	Study group				Control group			
	Before	After 1	After 2	p-value (Sig.)	Before	After 1	After 2	p-value (Sig.)
RR (breath/m)	23.20	20.83	19.67	.030 (S)	22.33	24.33	26.67	.4820 (NS)
SpO_2 (%)	96.17	97.30	97.53	.001 (HS)	95.70	95.20	94.43	.077 (NS)

Before: before implementing the intervention; after 1: 5 minutes after implementing the intervention; **after** 2: 10minutes after implementing the intervention; **NS**: Non-Significant (P value >0.05); **S**: Significant (P value ≤0.05- > 0.01) ; **HS** : Highly Significant (P value ≤0.01).

Discussion

Socio-Demographic Characteristics of Patients with Acute Coronary Syndrome

The socio-demographic analysis of patients in this study (Table 1) shows that the majority of participants in both the study and control groups were between the ages of 50-69 years (60% in the study group and 63.3% in the control group). This finding is consistent with a randomized clinical trial by Hasheminia et al. (2021), which reported a mean patient age of 62.16 ± 10.47 years (range: 42–84 years). The aging process is known to impact anatomical and physiological functions, leading to a decline in organ efficiency and overall body resistance. This may explain why ACS is more prevalent among older adults. Regarding sex distribution, 76.7% of the intervention group and 73.3% of the control group were male, aligning with previous research by Alimohammad et al. (2018), which found a higher incidence of ACS in men (54.3% in the study group and 65.7% in the control group). However, this result contradicts the findings of Ghadicolaei et al. (2019), which reported a higher prevalence of ACS in women (51.7% in the control group and 38.3% in the intervention group). These discrepancies may be due to variations in lifestyle, genetics, and healthcare access between different populations.

In terms of marital status, the majority of patients in both groups were married (83.3% in the intervention group and 80% in the control group). This finding aligns with a study by Partovi et al. (2019), which reported that 93.3% of patients in the intervention group and 96.7% in the control group were married. Marriage has been associated with better health outcomes due to increased social and emotional support, which may contribute to the ability to cope with chronic conditions like ACS.

The educational background of participants revealed that 40% of the intervention group and 36.7% of the control group were illiterate. These results differ from those reported by Ghanbari et al. (2022), where 50% of the intervention group and 56.25% of the control group had only a high school diploma. Educational level is a crucial factor in health literacy, influencing individuals' ability to understand and adhere to preventive and treatment strategies for ACS.

Regarding occupation, this study found that 40% of the intervention group and 30% of the control group were self-employed. These findings contrast with those of Sahrayi Zarghi et al. (2020), where 40.6% of the intervention group and 59.4% of the control group were employed in formal sectors. Employment type may influence lifestyle factors such as diet, stress levels, and access to healthcare, which can contribute to ACS risk.

Smoking habits were also assessed, revealing that approximately 50% of the intervention group and 46.7% of the control group were current smokers. This finding aligns with the study conducted by Shim & Hwang (2017), which reported that 43.7% of the intervention group and 51.5% of the control group were active smokers. Smoking is a well-established risk factor for ACS, contributing to endothelial dysfunction and atherosclerosis progression.

Clinical Characteristics of ACS Patients

Table 2 shows that 56.7% of the intervention group and 66.7% of the control group were classified as overweight (BMI >25 kg/m²). This finding is consistent with research by El Hajj et al. (2023) in Qatar, which found that 42.5% of the intervention group and 37.3% of the control group were overweight. However, these results contrast with those of Weibel et al. (2016), which reported 36.8% of the control group and 52.6% of the intervention group had normal weight. Obesity is a significant risk factor for ACS as it is linked to hypertension, diabetes, and metabolic syndrome.

Regarding chronic diseases, 43.3% of the intervention group and 63.3% of the control group had both hypertension (HTN) and diabetes mellitus (DM). This finding differs from the study by Partovi et al. (2018), where 63.3% of the intervention group and 36.7% of the control group had HTN. The presence of multiple comorbidities in ACS patients is concerning, as it increases the complexity of management and treatment outcomes.

In terms of medication use, 36.7% of the intervention group and 60% of the control group were on antihypertensive and anti-diabetic drugs. This result is inconsistent with the findings of Veiskaramian et al. (2021), which reported that 27.6% of the intervention group and 16.1% of the control group were taking antihypertensive medications. Differences in prescribing patterns and healthcare access may account for these variations.

Comparison of Pulmonary Parameters Between Study and Control Groups

The analysis of pulmonary parameters (Table 3) indicates statistically significant improvements in respiratory rate (RR) and oxygen saturation (SpO_2) in the intervention group, while no significant changes were observed in the control group.

- Respiratory Rate (RR): The intervention group showed a significant decrease in RR ($p = 0.030$), suggesting that foot massage may have contributed to relaxation and improved breathing efficiency. In contrast, no significant difference was observed in the control group ($p = 0.482$).
- Oxygen Saturation (SpO_2): The intervention group demonstrated a statistically significant increase ($p = 0.001$), whereas no significant change was found in the control group ($p = 0.077$).

These findings align with those of Mohamed Abdelfatah Sliman et al. (2020), who examined the effects of foot massage on pain severity, hemodynamic parameters, and mechanical ventilation weaning time in critical care settings. Their study reported highly significant improvements in RR ($p \leq 0.001$) and SpO_2 ($p = 0.025$) in the intervention group. Similarly, Alimohammad et al. (2018) found significant changes in systolic and diastolic blood pressure, pulse rate, and respiratory rate among patients receiving hand and foot massage.

These results suggest that foot massage may serve as a valuable complementary therapy for ACS patients by promoting relaxation, enhancing oxygenation, and reducing physiological stress responses.

Conclusion

The findings of this study demonstrate that foot massage is an effective non-pharmacological intervention for improving pulmonary function in ACS patients. The intervention led to a significant reduction in respiratory rate and an increase in oxygen saturation levels, indicating enhanced respiratory efficiency. Given its simplicity, affordability, and non-invasive nature, foot massage can be integrated into the supportive care of ACS patients to optimize clinical outcomes.

Clinical Implications

- Foot massage can be safely implemented as a complementary therapy for ACS patients to improve respiratory function.
- Healthcare providers should consider incorporating massage therapy into cardiac rehabilitation programs to enhance patient well-being.
- Further large-scale randomized controlled trials are needed to validate these findings and explore additional physiological benefits of foot massage in ACS management.

DECLARATION SECTION

Availability of data and material: Data is available at the request of the corresponding author.

Funding: We have not received any funding to execute this research study nor the rigorous procedure of collecting data and other associated processes to conduct this study.

Conflict of Interest Statement: None

Authors' Contribution: All authors have read and approved the manuscript.

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