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Original Research Article

EVALUATION OF STRESS, HEART RATE VARIABILITY AND AUTONOMIC FUNCTION AMONG INDIVIDUALS ENGAGED IN BEGGING

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ABSTRACT

Background: Individuals engaged in begging may experience persistent socioeconomic adversity, psychological stress and social marginalisation, which may adversely affect autonomic regulation. Heart rate variability (HRV) and galvanic skin response (GSR) provide objective measures of cardiac and electrodermal autonomic activity. The present study evaluated perceived stress and autonomic function in individuals engaged in begging.

Materials and Methods: A cross-sectional observational study was conducted among 40 adults actively engaged in begging. Perceived psychological stress was assessed using the Perceived Stress Scale. Cardiac autonomic function was evaluated using electrocardiographic HRV analysis, including time-domain and frequency-domain parameters. GSR was recorded to assess electrodermal autonomic activity. Demographic and relevant clinical and lifestyle characteristics were also documented. Correlation analysis was performed to examine associations between perceived stress and autonomic parameters.

Results: The mean age of participants was 46.2 ± 11.4 years, with males comprising 60%. The mean perceived stress score was 21.4 ± 5.8, with 57.5% showing moderate and 20% showing high stress. Increasing stress was associated with lower HRV, particularly SDNN, RMSSD and HF power, while the LF/HF ratio increased. Participants with greater perceived stress also demonstrated higher baseline GSR, greater response amplitude and more frequent spontaneous responses. PSS showed negative correlations with RMSSD ($r = -0.48$, $p = 0.002$) and HF power ($r = -0.44$, $p = 0.004$), and positive correlations with LF/HF ratio ($r = 0.41$, $p = 0.008$) and baseline GSR ($r = 0.46$, $p = 0.003$).

Conclusion: Greater perceived stress among individuals engaged in begging was associated with reduced vagally mediated HRV and increased electrodermal sympathetic arousal.

Keywords: Begging; Psychological Stress; Heart Rate Variability; Autonomic Function; Galvanic Skin Response; Perceived Stress; Sympathetic Activity; Vagal Modulation.

INTRODUCTION

Individuals engaged in begging constitute a socially and economically vulnerable group who may be exposed to persistent financial insecurity, inadequate housing, food insecurity, social exclusion and concerns regarding personal safety. Such circumstances can result in repeated psychological stress and may adversely influence physical as well as mental well-being. Research among homeless and marginally housed populations has reported substantial levels of psychological distress and demonstrated associations between food insecurity and depression, anxiety and stress.[1,2] Prolonged exposure to such adverse circumstances may affect physiological systems responsible for maintaining homeostasis. Psychological stress activates the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis, producing physiological responses that facilitate adaptation to perceived threats. While these responses are beneficial during short-term stress, repeated or persistent activation may result in altered autonomic regulation and impaired cardiovascular adaptability.[3] Chronic psychosocial stress has been associated with changes in cardiovascular autonomic activity and may contribute to increased susceptibility to cardiovascular disease.[4] Evaluation of autonomic function may therefore provide an objective means of identifying physiological consequences associated with prolonged psychological stress. Heart rate variability (HRV) is a non-invasive method used to assess beat-to-beat fluctuations in cardiac cycle length and provides valuable information regarding cardiac autonomic modulation. Time-domain measures such as standard deviation of normal-to-normal intervals (SDNN) and root mean square of successive differences (RMSSD), together with frequency-domain indices, are commonly used for evaluating autonomic regulation.[5] Reduced HRV, particularly reduced indices associated with vagal modulation, has been observed in individuals exposed to psychological stress. A systematic review and meta-analysis demonstrated a significant relationship between stress and alterations in HRV, supporting the usefulness of HRV as a physiological marker of stress-related autonomic changes.[6] Socioeconomic disadvantage may also influence cardiac autonomic function. Individuals occupying lower socioeconomic positions have been reported to exhibit altered autonomic regulation, which may represent one mechanism linking social circumstances with cardiovascular morbidity.[7] Research from the Whitehall II study demonstrated an association between social position and cardiac autonomic function, suggesting that psychosocial and socioeconomic factors may contribute to differences in cardiovascular risk.[8] Individuals engaged in begging may experience several overlapping disadvantages, including unstable income, limited access to healthcare, poor living conditions and social marginalisation. These factors may collectively increase their psychological and physiological stress burden. In addition to HRV, galvanic skin response (GSR), also referred to as electrodermal activity, can provide information regarding autonomic arousal. GSR reflects changes in electrical conductance of the skin, primarily resulting from sympathetic activation of eccrine sweat glands.[9] Electrodermal activity has been extensively used in psychophysiological research because skin conductance changes rapidly in response to emotional and cognitive stimuli. Experimental research has demonstrated that electrodermal responses can provide an objective measure of physiological arousal during psychological stress.[10] Although psychological distress and health inequalities among homeless and socially disadvantaged populations have received research attention, relatively little is known about the relationship between perceived stress and objective autonomic parameters among individuals specifically engaged in begging. The Indian social context may further influence these relationships because of differences in living conditions, social support, access to healthcare and occupational circumstances. Assessment of both psychological stress and autonomic parameters may therefore provide a more comprehensive understanding of the physiological consequences of social vulnerability. Combining a validated stress assessment with HRV and GSR measurements may help identify alterations in autonomic regulation that could otherwise remain undetected. The present study was consequently undertaken to evaluate stress, heart rate variability and autonomic function among individuals engaged in begging and to explore the relationship between perceived psychological stress and objective autonomic parameters.

Aim and objectives: To assess psychological stress, heart rate variability and autonomic function among individuals engaged in begging, and to determine the association between perceived stress and cardiac autonomic parameters, including heart rate variability and galvanic skin response.

MATERIALS AND METHODS

Study design: The study was conducted as a cross-sectional observational study to evaluate psychological stress, heart rate variability (HRV) and autonomic function among individuals engaged in begging.

Study participants: A total of 40 individuals engaged in begging were recruited for the study. Participants were approached at identified public locations and were invited to participate voluntarily. The purpose and procedures of the study were explained to each participant in a language they could understand. Written informed consent was obtained before enrolment.

Inclusion criteria

Individuals aged 18 years and above who were actively engaged in begging and were willing to participate were included. Participants who were able to understand the study instructions and cooperate with the physiological recordings were considered eligible.

Exclusion criteria

Individuals with a known history of major cardiovascular disease, clinically significant cardiac arrhythmias, uncontrolled hypertension, neurological disorders, severe psychiatric illness or other systemic conditions likely to influence autonomic function were excluded. Individuals taking medications that could substantially alter heart rate or autonomic activity were also excluded. Participants who were unable to remain still during the physiological recordings or who did not provide complete information were excluded from analysis.

Outcome measures: The primary outcome measures were PSS score, HRV parameters and GSR parameters. Secondary variables included resting heart rate, systolic and diastolic blood pressure and relevant demographic and lifestyle characteristics. The relationship between psychological stress scores and autonomic parameters was subsequently evaluated.

Demographic and Clinical Assessment: A structured proforma was used to collect demographic and relevant clinical information. Details regarding age, sex, duration of involvement in begging, living circumstances, smoking, tobacco use, alcohol consumption, sleep pattern and known medical illnesses were recorded. Height and weight were measured using standard procedures, and body mass index was calculated as weight in kilograms divided by height in metres squared. Resting blood pressure and pulse rate were measured after an adequate period of quiet sitting.

Assessment of Psychological Stress: Psychological stress was assessed using the Perceived Stress Scale (PSS). The questionnaire was administered in a quiet environment after explaining the response options to the participants. The scale assessed the individual's perception of stress and the extent to which situations during the preceding period were considered unpredictable, uncontrollable or overwhelming. The total score was calculated according to the standard scoring procedure, with higher scores indicating greater perceived stress.

Assessment of Heart Rate Variability: Cardiac autonomic function was evaluated using HRV analysis. Participants were instructed to avoid strenuous physical activity, caffeinated beverages, smoking and other stimulants for an appropriate period before the assessment. Recordings were performed in a quiet laboratory with minimal external disturbance. After allowing the participant to rest in the supine position, a standard ECG recording was obtained using a validated physiological data acquisition system. The participant was instructed to remain relaxed and minimise body movements during the recording. The ECG signal was examined for artefacts and ectopic beats before HRV analysis. Time-domain HRV parameters including mean RR interval, SDNN, RMSSD, NN50 and pNN50 were obtained. Frequency-domain parameters including total power, low-frequency (LF) power and high-frequency (HF) power were also assessed. The LF/HF ratio was calculated to describe the balance of oscillatory cardiac autonomic modulation. All recordings were performed under similar environmental conditions to minimise the influence of external factors.

Assessment of Galvanic Skin Response: Galvanic skin response (GSR), also referred to as electrodermal activity, was recorded as an additional indicator of autonomic arousal. After adequate rest, suitable electrodes were placed over the palmar surface of the hand after ensuring appropriate skin contact. Participants were instructed to remain relaxed and avoid unnecessary hand or body movements. Baseline skin conductance was recorded, followed by measurement of electrodermal responses during the standardised recording period. Parameters such as baseline skin conductance, skin conductance response amplitude and frequency of spontaneous responses were documented according to the capabilities of the recording system.

Data analysis: The collected data were entered into a Microsoft Excel spreadsheet and analysed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range according to the distribution of the data. Categorical variables were presented as frequencies and percentages. Normality was assessed before selection of statistical tests. Pearson's or Spearman's correlation analysis was performed to determine the relationship between perceived stress scores and HRV/GSR parameters, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 40 individuals engaged in begging were included in the study. The participants had a mean age of approximately 46 years. Males constituted a slightly higher proportion of the study population. The demographic and baseline characteristics are presented in Table 1. The mean perceived stress score was 21.4 ± 5.8, indicating a moderate level of perceived stress in the study population. Approximately one-fourth of the participants had low perceived stress, whereas more than half demonstrated moderate stress and the remaining participants had high perceived stress (Table 2). Participants with higher perceived stress scores demonstrated lower HRV values. SDNN and RMSSD were comparatively reduced among participants with high stress. HF power was also lower, while the LF/HF ratio was higher in individuals with greater perceived stress, suggesting altered cardiac autonomic modulation (Table 3). GSR findings demonstrated higher baseline skin conductance and greater skin conductance response amplitude among participants reporting higher stress. The number of spontaneous electrodermal responses was also greater in the high-stress group (Table 4). Correlation analysis showed a negative correlation between PSS score and RMSSD ($r = -0.48$, $p = 0.002$) and between PSS score and HF power (r = −0.44, p = 0.004). Conversely, PSS score demonstrated a positive correlation with LF/HF ratio (r = 0.41, p = 0.008) and baseline GSR (r = 0.46, p = 0.003). These findings suggested that greater perceived stress was associated with reduced cardiac vagal modulation and increased electrodermal sympathetic arousal.

Table 1: Demographic and baseline characteristics of participants (n=40)

Parameter	Value
Age (years)	46.2 ± 11.4
Male, n (%)	24 (60.0)
Female, n (%)	16 (40.0)
Duration of begging (years)	8.1 ± 5.6
BMI (kg/m²)	22.8 ± 3.4
Systolic blood pressure (mmHg)	128.6 ± 14.2
Diastolic blood pressure (mmHg)	81.7 ± 8.9
Resting heart rate (beats/min)	82.5 ± 8.7

Table 2: Distribution of participants according to perceived stress level

Stress	PSS score	Participants, n (%)
Low stress	0–13	9 (22.5%)
Moderate stress	14–26	23 (57.5%)
High stress	27–40	8 (20.0%)
Total		40 (100%)

Table 3: Heart rate variability parameters according to perceived stress level

HRV parameter	Low stress (n=9)	Moderate stress (n=23)	High stress (n=8)
Mean RR (ms)	762 ± 58	728 ± 61	695 ± 54
SDNN (ms)	39.2 ± 7.1	31.4 ± 6.8	25.7 ± 5.9
RMSSD (ms)	31.8 ± 6.5	24.1 ± 5.7	18.6 ± 4.8
pNN50 (%)	10.7 ± 3.2	6.8 ± 2.6	4.1 ± 1.8
LF power (ms²)	315 ± 76	296 ± 71	278 ± 69
HF power (ms²)	238 ± 57	181 ± 48	132 ± 42
LF/HF ratio	1.34 ± 0.31	1.67 ± 0.39	2.08 ± 0.47

Table 4: Galvanic skin response parameters according to perceived stress

GSR parameter	Low stress (n=9)	Moderate stress (n=23)	High stress (n=8)
Baseline skin conductance (μS)	6.2 ± 1.4	7.8 ± 1.7	9.1 ± 2.0
Response amplitude (μS)	2.4 ± 0.7	3.3 ± 0.9	4.2 ± 1.1
Spontaneous responses/min	3.2 ± 1.1	4.8 ± 1.4	6.1 ± 1.7
Recovery time (sec)	13.8 ± 3.5	17.2 ± 4.1	20.1 ± 4.6

DISCUSSION

The present study evaluated psychological stress, heart rate variability (HRV) and autonomic function among 40 individuals engaged in begging. The findings demonstrated a considerable burden of perceived stress, with the majority of participants reporting moderate stress and a smaller proportion experiencing high stress. This finding may reflect the cumulative influence of financial insecurity, social marginalisation, uncertain daily income, inadequate living conditions and limited access to healthcare. Socioeconomic disadvantage has increasingly been recognised as an important determinant of autonomic regulation, with studies demonstrating associations between lower socioeconomic circumstances and altered HRV.[11,12] A progressive reduction in HRV parameters was observed with increasing levels of perceived stress. Participants with high stress had lower SDNN, RMSSD and pNN50 compared with those reporting low stress. These findings suggest reduced cardiac autonomic flexibility and diminished vagally mediated modulation among individuals experiencing greater psychological stress. HRV reflects the dynamic interaction between sympathetic and parasympathetic influences on the sinoatrial node and is considered a useful non-invasive marker of autonomic regulation.[13,14] The reduction in RMSSD was particularly noteworthy because this parameter is predominantly influenced by parasympathetic cardiac activity. The negative correlation observed between perceived stress and RMSSD suggested that increasing psychological stress was accompanied by reduced vagal modulation. Similar findings have been reported in studies investigating autonomic responses to psychosocial stress, where individuals with poorer stress regulation demonstrated attenuated vagal responses and slower autonomic recovery.[15] The ability of the autonomic nervous system to adjust appropriately during stressful circumstances is an important component of physiological resilience.[16] The reduction in HF power among participants with higher stress further supported the possibility of diminished parasympathetic influence. Although HF-HRV is strongly influenced by respiratory sinus arrhythmia and vagal activity, its interpretation requires consideration of respiration and recording conditions. Therefore, the present findings should be interpreted as evidence of altered parasympathetic cardiac modulation rather than as an isolated measure of vagal activity. Contemporary HRV research emphasises interpretation of multiple time- and frequency-domain indices together rather than depending upon a single parameter.[17] An increase in the LF/HF ratio was observed progressively across the stress categories. This finding may indicate a relative alteration in autonomic balance in participants with higher perceived stress. However, LF/HF should not be regarded as a direct quantitative measure of sympathovagal balance because LF power is influenced by several physiological mechanisms and is not exclusively sympathetic.[18] The concurrent reduction in RMSSD and HF power with an increase in LF/HF nevertheless indicated a pattern compatible with reduced vagal modulation in participants reporting greater psychological stress. The electrodermal findings provided additional evidence of altered autonomic activity. Baseline skin conductance, response amplitude and spontaneous responses were higher among participants with moderate and high stress. Electrodermal activity reflects sweat gland activity and is principally mediated by sympathetic cholinergic pathways. Consequently, increased electrodermal activity may represent enhanced sympathetic arousal during psychological stress. Recent investigations using multimodal physiological recordings have demonstrated that electrodermal measures can provide useful information regarding acute mental stress and may complement HRV measurements.[19,20] The positive association between perceived stress and baseline galvanic skin response was also important. Psychological stress is not merely a subjective experience but can produce measurable physiological alterations through activation of the central autonomic network. HRV and electrodermal activity represent partly different dimensions of autonomic regulation; therefore, their combined assessment may provide a more comprehensive understanding of stress-related physiological changes.[20,21] Participants with higher stress also demonstrated prolonged recovery of electrodermal responses. Delayed recovery may indicate reduced physiological adaptability following a stress response. Recent work examining autonomic responses during mental stress has shown that individuals differ considerably in their capacity to return towards baseline following a stressful stimulus. Reduced autonomic recovery may represent an important physiological characteristic of persistent stress exposure.[15,16] The findings have potential cardiovascular implications. Chronic psychological stress may influence cardiovascular health through repeated activation of neural, autonomic and inflammatory pathways. Recent evidence has demonstrated that lower socioeconomic status may be associated with cardiovascular risk through mechanisms involving stress-related neural activity and altered HRV.[22] Furthermore, autonomic responses to mental stress have been associated with subsequent cardiovascular mortality, highlighting the potential clinical relevance of abnormal autonomic stress responses.[23] The present findings should, however, be interpreted in the context of the study population. Individuals engaged in begging may experience multiple simultaneous stressors, including unstable income, food insecurity, social stigma and occupational uncertainty. These factors may interact with sleep, physical activity, nutritional status and other lifestyle characteristics, potentially influencing autonomic measurements. Evidence from populations experiencing poverty has also demonstrated an association between socioeconomic circumstances and resting HRV, supporting the possibility that social conditions may become biologically embedded through autonomic pathways.[12] An important strength of the present study was the simultaneous assessment of psychological stress, HRV and galvanic skin response. The consistency between subjective stress scores and objective autonomic measures strengthens the interpretation that psychological stress was accompanied by measurable physiological alterations. Similar multimodal approaches combining HRV and electrodermal activity have demonstrated improved characterisation of physiological stress responses compared with individual measures alone.[19,20] Nevertheless, several limitations should be acknowledged. The cross-sectional design prevented establishment of a causal relationship between socioeconomic circumstances, psychological stress and autonomic dysfunction. The relatively small sample size also limited the generalisability of the findings. HRV can be affected by age, sex, physical activity, sleep, medications, smoking, caffeine intake, hydration and respiratory pattern, while electrodermal activity is influenced by ambient temperature, skin condition and movement. These variables should be controlled more rigorously in future investigations.[17,18] Overall, the study demonstrated that greater perceived stress among individuals engaged in begging was associated with reduced vagally mediated HRV and increased electrodermal activity. The findings suggest that persistent psychosocial adversity in this vulnerable population may be accompanied by measurable alterations in autonomic regulation. Larger longitudinal studies incorporating cardiovascular risk factors, sleep, nutritional status and mental health assessments are required to determine whether these autonomic alterations predict future morbidity. Intervention-based studies involving relaxation techniques, meditation, yoga, counselling or HRV biofeedback may also help determine whether improvement in psychological stress can restore autonomic flexibility.

CONCLUSION

Individuals engaged in begging demonstrated considerable psychological stress accompanied by reduced vagally mediated heart rate variability and increased electrodermal activity. The observed associations suggest altered autonomic regulation with increasing stress levels. Community-based screening, psychosocial support and stress-management interventions may help reduce potential cardiovascular risks in this vulnerable population.

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