Sigma Theta Tau International's 29th International Nursing Research Congress

Symptom Clusters in Patients With Acute Coronary Syndrome: Comparison of Person-Centered and Variable-Centered Cluster Analyses

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Purpose: Patients with acute coronary syndrome (ACS) often experience multiple concurrent symptoms, known as symptom clusters (Rosenfeld, Knight, Steffen, Burke, Daya, & DeVon, 2015; Ammouri, Al-Daakak, Isac, Gharaibeh, & Al-Zaru, 2016). Researchers have employed a variety of analytic methods to identify symptom clusters in cardiovascular conditions, often without a conceptual or empirical rationale (Herr et al., 2015). This makes meta-analyses or comparisons between studies challenging. The objectives of this secondary data analysis were to identify symptom clusters and compare symptom cluster results in a cohort of patients with ACS using two variable-centered and three person-centered analytic approaches.

Methods: This analysis is part of a larger prospective, multi-center study that examined the influence of sex on symptom characteristics during ACS. The sample included 474 patients who presented to one of five emergency departments (ED) in the Midwest, West, Southwest, and the Pacific Northwest regions of the United States. Individuals with symptoms triggering a cardiac evaluation, who were at least 21 years old, fluent in English, and who walked in or arrived by emergency medical services were eligible for the study. Patients were excluded if they had an exacerbation of heart failure (B-type natriuretic peptide ≥ 500 pg/ml), were transferred from a hemodialysis facility, were referred for evaluation of a dysrhythmia, did not speak English or Spanish, or were unable to understand and provide written informed consent for the study. Symptoms were assessed within 15 minutes of ED presentation utilizing the validated 13-item ACS Symptom Checklist. Variable-centered approaches included exploratory factor analysis (EFA), principal components analysis (PCA), and confirmatory factor analysis (CFA). These tests assume that the population is homogeneous and focus on the relationships between variables; in this case, symptoms (Everitt, Landau, & Leese, 2011). In contrast, person-centered approaches, including hierarchical agglomerative analysis, k-means clustering, and latent class analysis (LCA), capture population heterogeneity by grouping persons into categories or subgroups based on their similarities on a set of observed variables (e.g. symptoms, age, sex, or diagnosis) (Dong et al., 2016; Fukuoka, Lindgren, Rankin, Cooper, & Carroll, 2007). For LCA, fit statistics used to determine the best-fitting model include log likelihood (LL), L^2 (likelihood ratio chi squared statistic), Akaike information criterion (AIC), Bayesian information criterion (BIC), and R^2 entropy. EFA and PCA results were validated using CFA.

Results: The two variable-centered approaches resulted in 4-factor solutions. Factor loadings ranged from 0.43 to 0.75. The factors were labeled: 1) *Chest symptoms* (chest discomfort, chest pressure, and chest pain); 2) *Exertion-like* (lightheadedness, palpitations, fatigue, and shortness of breath); 3) *Non-chest pain* (shoulder pain, arm pain, and upper back pain); and 4) *Gastrointestinal symptoms* (nausea, sweating, and indigestion). Two of the three person-centered approaches, agglomerative and LCA, also resulted in a 4-class solution. The covariates of age, race, and sex were added to the LCA model resulting in best model fit statistics of LL (-3444.63), L^2 (5805.12), AIC (7059.27), BIC (7310.62), and R^2 entropy 0.6955). The clusters were labeled: 1) *Chest symptoms* (40% of sample); 2) *Heavy symptom burden* (25% of sample); 3) *Classic symptoms* (19% of sample); and 4) *Low symptom burden* (15% of sample). K-means analysis initially revealed a 6-class solution including: 1) *Classic symptoms;* 2) *Chest symptoms only;* 3) *Gastrointestinal;* 4) *Low symptom burden;* 5) *Heavy symptom burden; and* 6) *Pain & discomfort.* However, following a cluster plot analysis, the 6 factors were reduced to 3 clusters and labeled: 1) *Low symptom burden;* 2) *Chest symptoms;* and 3) *Classic symptoms*.

Conclusion: The number of clusters was similar across statistical techniques. However, individual symptoms and patient characteristics varied within clusters. K-means with further optimization procedures resulted in the loss of a gastrointestinal symptom cluster. Retaining this cluster is clinically relevant since patients often erroneously label their symptoms as “heartburn”. Triage personnel may be more likely to forgo cardiac diagnostic testing if the patient self-diagnoses their condition as “heartburn”. Choosing a cluster analytic technique should be based on theoretical concepts and study aims. If the research is exploratory, a variable-centered approach is recommended. If the investigators have a hypothesis about symptom clusters for a specific condition or aim to cluster symptoms by individual groups, then LCA is recommended.

Title:

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Keywords:

Acute Coronary Syndrome, Analytic Methods and Symptom Clusters

References:

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Abstract Summary:

The objective of this study was to identify symptom clusters and compare cluster results in a cohort of 474 patients with acute coronary syndrome using two variable-centered and three person-centered analytic approaches. Three to four clusters were identified across statistical techniques and the clusters had more similarities than differences.

Content Outline:

1. Introduction:

   Example- Single symptoms versus symptom clusters.

   Example- What is known about symptom cluster analysis in cardiovascular patients.

2. Body (Methods):

   Main point 1-Design, sample, setting, measures

      Supporting point- This is a secondary analysis of data from a large, prospective, multi-site, clinical study. Patients presenting to the emergency department with symptoms triggering a cardiac work-up were enrolled. Symptoms were measured with the 13-item Acute Coronary Syndrome (ACS) Symptom Checklist.

   Main point 2- Statistical analyses
      Supporting point- Two variable-centered and three person-centered cluster analytic methods were employed to analyze the data.
      Supporting point- Define and describe the various methods.

   Main point 3-Fit Statistics
      Supporting point- Present Fit statistics and discuss the meaning of the statistics.

3. Results & Conclusions:
   Example- The two variable-centered approaches resulted in 4-factor solutions. Factor loadings ranged from 0.43 to 0.75. The factors were labeled based on their characteristics.

   Example- The number of clusters was similar across statistical techniques. However, individual symptoms and patient characteristics varied within clusters.

   Example- Choosing a cluster analytic technique should be based on theoretical concepts and study aims.

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