

Archaeological Data Patterns Through Statistical Analysis: Jambi Ancient Graves, Indonesia

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ABSTRACT

This study explores tombstone characteristics to reveal socio-cultural patterns of past societies, particularly in ancient Jambi. Traditional archaeology often relies on qualitative methods, which can overlook underlying patterns in the data. This research addresses that gap by integrating quantitative analysis, specifically cluster analysis, to complement and enhance qualitative interpretations. Using primary data from 50 graves, which include both categorical and continuous variables, the study identifies relationships among tombstone features and classifies them into five distinct clusters. These clusters reflect variations in socio-economic status and illuminate burial practices and cultural traditions of the time. By combining qualitative and quantitative approaches, the research offers a more holistic view of historical contexts and social stratification. The findings underscore the importance of using mixed data clustering in archaeology to uncover patterns that may not be visible through conventional methods alone. This methodological innovation contributes to improving archaeological research practices in Indonesia and has the potential to inform future studies across cultural and historical contexts. Overall, this research not only deepens our understanding of the social fabric of ancient Jambi but also paves the way for broader applications of data-driven approaches in cultural heritage and archaeological investigations.

Keywords : Analysis of Clusters; Graves; Archaeology; Jambi

ABSTRAK

Studi ini mengeksplorasi karakteristik batu nisan untuk mengungkap pola sosial-budaya masyarakat masa lalu, khususnya di Jambi kuno. Arkeologi tradisional sering kali mengandalkan metode kualitatif, yang dapat mengabaikan pola yang mendasarinya dalam data. Penelitian ini mengatasi kesenjangan tersebut dengan mengintegrasikan analisis kuantitatif, khususnya analisis kluster, untuk melengkapi dan meningkatkan interpretasi kualitatif. Dengan menggunakan data primer dari 50 makam, yang mencakup variabel kategoris dan kontinu, penelitian ini mengidentifikasi hubungan di antara fitur batu nisan dan mengklasifikasikannya ke dalam lima kluster yang berbeda. Kluster-kluster ini mencerminkan variasi status sosial-ekonomi dan menjelaskan praktik penguburan dan tradisi budaya saat itu. Dengan menggabungkan pendekatan kualitatif dan kuantitatif, penelitian ini menawarkan pandangan yang lebih holistik tentang konteks historis dan stratifikasi sosial. Temuan-temuan tersebut menggarisbawahi pentingnya menggunakan pengelompokan data campuran dalam arkeologi untuk mengungkap pola-pola yang mungkin tidak terlihat melalui metode konvensional saja. Inovasi metodologis ini berkontribusi untuk meningkatkan praktik penelitian arkeologi di Indonesia dan berpotensi untuk menginformasikan penelitian masa depan di seluruh konteks budaya dan sejarah. Secara keseluruhan, penelitian ini tidak hanya memperdalam pemahaman kita tentang struktur sosial Jambi kuno tetapi juga membuka jalan bagi aplikasi pendekatan berbasis data yang lebih luas dalam warisan budaya dan investigasi arkeologi.

Kata Kunci : Analisis Clustering; Makam; Arkeologi, Jambi

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INTRODUCTION

Jambi Province possesses a long-standing and rich historical heritage. This is evidenced by the discovery of cultural remains from past civilizations, including settlement sites, religious ceremonial locations, ports, and centers of political and economic activity dating back to the 7th century CE along the Batanghari River. The Batanghari River also served as a major axis for political and economic dynamics involving prominent kingdoms such as Malayu, Srivijaya, Singhasari–Majapahit, and later, Islamic and colonial powers. However, long before the emergence of classical civilization, earlier researchers had uncovered traces of human activity in the Jambi region dating back to the Mesolithic period. The earliest discovery was made by August Tobler in 1913 during his excavation at Ulu Tiangko Cave, Merangin Regency, where he found lithic flakes. In 1926, J. Zwierzycki discovered obsidian and stone artifacts in a cave near Ngalan, Merangin (Heekeren, 1972; Budisantosa & Tri Marhaeni, 2006).

According to Wiwik and Tarigan (2006), by the 7th century CE (664 CE), the Malay ethnic group had founded the Malayu Kingdom (mo-lo-yeu), developing a syncretic Buddhist-Malay culture. By the 13th century CE, this culture declined and was gradually replaced by an Islamic-Malay cultural orientation. Hence, the indigenous Malay people of Jambi developed three cultural phases throughout their history: prehistoric Malay culture, Buddhist Malay culture, and Islamic Malay culture (Wiwik S. & Tarigan, 2006).

In the Islamic period, Jambi's development was shaped by political, sociocultural, and commercial dynamics. Islam initially entered the region through trade networks operating in the Strait of Malacca when the Srivijaya polity was at its zenith in the 7th century CE (Andhifani, 2018). According to Azyumardi Azra (in Andhifani, 2018; Karim, 2009), Islam was disseminated through four main channels: (1) direct contact with Arab traders, (2) propagation by Islamic missionaries, (3) conversion of local rulers, and (4) wider adoption in the 12th–13th centuries CE. Although Islam was introduced as early as the first century of the Hijri calendar, it only gained substantial following in the archipelago by the 12th century CE (Andhifani, 2018; Karim, 2009).

Local sources mention that after the decline of Majapahit and the rise of Islam, Jambi came under the rule of Orang Kayo Hitam, the son of Datuk Paduka Berhala and Princess Selaras Pinang Masak. Oral tradition asserts that Datuk Paduka Berhala was a descendant of Zainal Abidin of Turkish origin, who became the ruler of Berhala Island, while Princess Selaras hailed from the Minangkabau region (Boers, 1840; Mennes, 1932; Tideman, 1938). Kathirithamby-Wells (1993) notes that their marriage led to significant Minangkabau migration into Jambi, with settlements spreading along the Batanghari River up to Muara Tambesi, later becoming a vital trade hub between the inland and coastal regions.

During the Islamic period, numerous cultural artifacts were established, including mosques, tombs, and manuscripts. Islamic tombs represent a significant subsystem of religious culture and are suitable for comprehensive qualitative archaeological analysis. Across Indonesia, Islamic, Christian, and Confucian burials have been studied through qualitative methods (Saptono & Widyastuti, 2019). In Jambi, archaeological findings such as ancient mosques and tombs affirm the early presence of Islam. These include inscriptions and other artifacts providing insights into the history and expansion of Islam in the region (Sinurat et al., 2024).

Archaeological evidence from upstream areas like Kerinci and Merangin includes Islamic tombs and cylindrical megaliths (Putra, 2019). Notably, tombs referred to as *jihat* are recognized by local communities as belonging to early Islamic propagators and leaders (Setia, 2022; Sunliensyar, 2016). Another example is the Muara Sawah cemetery in Sarolangun, interpreted as a reused classical site during the Islamic period, reflecting the continued sacrality

of the site (Izza, Wardoyo, et al., 2021). In downstream Jambi, Islamic tombs reflect the cultural legacy of the Jambi Sultanate, including the Taman Rajo Cemetery, Abdul Nasruddin's Tomb, Merah Mato's Tomb, Princess Ayu's Tomb Complex, Sipin Lake Cemetery, and Talang Jauh Cemetery (Sinurat et al., 2024).

Despite these important discoveries, Islamic archaeology in Indonesia—and Jambi in particular—has been predominantly qualitative. While qualitative methods provide rich interpretative insights, they are often limited by subjectivity and lack the capacity to detect broader patterns or generate generalizable conclusions. Therefore, there is a need to introduce quantitative methods to produce more objective and measurable analysis. Quantitative archaeology plays a crucial role in systematically and impartially analyzing archaeological datasets. By applying statistical methodologies, this research aims to measure, categorize, and better understand archaeological evidence, including the spatial distribution and architectural features of tombs.

Quantitative methods provide a robust framework for generating more precise generalizations about historical societies, such as demographic distributions, intergroup interactions, or cultural transformations over time. Moreover, statistical data facilitate explicit comparisons across sites or cultures, thereby enhancing our understanding of socio-economic processes in history.

In fact, statistical analysis in archaeology has long been practiced outside Indonesia. Kotz and Johnson (1982) introduced foundational concepts in this field, later expanded by Buck using multidimensional scaling and automated classification. In the 1980s, European scholars adopted multivariate techniques like Principal Component Analysis (PCA) and Factorial Correspondence Analysis (FCA), which offered powerful tools to synthesize large archaeological datasets (Kotz & Johnson, 1982). These statistical approaches have significantly contributed to understanding archaeological questions and led to collaborations between archaeologists and statisticians on chronological modeling and site characterization. Many such interdisciplinary efforts have been published in international journals of applied statistics and archaeology (Bellanger, Coulon, et al., 2021; Bellanger et al., 2006; Bellanger, Tomassone, et al., 2021; Bellanger & Husi, 2012).

In this context, the present study represents an initial step toward quantitatively identifying Islamic historical heritage in Jambi using statistical analysis. Islamic artifacts and ancient Islamic tombs are systematically examined through measurable variables including morphology, accessibility, and archaeological content. The outcomes of this research are expected to provide a preliminary mapping of Islamic cultural distributions in Jambi and contribute to the broader advancement of archaeological research methodologies in Indonesia.

RESEARCH METHOD

This study employs both descriptive and inferential statistical approaches. Descriptive statistics are used to illustrate the characteristics of Islamic tombs in Jambi, while inferential statistics are applied to classify and identify relationships between variables using Chi-Square analysis and Clustering analysis.

Chi-Square analysis is conducted to examine the association between tomb decoration descriptions and their respective locations. The Chi-Square test is a form of associative test involving two variables displayed in a contingency table, typically measured on nominal or ordinal scales. From this contingency table, hypotheses can be constructed to determine whether there is a statistically significant relationship between the categories of the variables. According to Bendixen (2008), if no relationship is found, it can be concluded that the

categories are independent, meaning the frequency of occurrence in one category is not influenced by another.

In this study, the Chi-Square hypothesis testing addresses the second research problem by testing for independence between variables. The general form of the hypothesis for each variable pair is:

- H_0 : The two variables are independent.
- H_1 : The two variables are not independent (i.e., they are associated).

The second analytical method employed is Clustering Analysis, aimed at classifying Islamic tombs in Jambi into meaningful groups. Clustering, a type of multivariate analysis, groups observation units into clusters based on the similarity of measured variables—objects within the same cluster are more similar to each other than to those in other clusters. This analysis is often visualized using a dendrogram (tree diagram), which facilitates an informative examination of clustering patterns (Hair, 2009).

The clustering process typically involves several stages: data preprocessing, selecting an appropriate clustering algorithm, determining the number of clusters, clustering the data, and interpreting the results. Each stage plays a crucial role in extracting meaningful insights. Data preprocessing includes handling missing values, encoding categorical variables, and normalizing or scaling numeric variables, thereby ensuring compatibility with the clustering algorithm and appropriate treatment of variable types (Baxter, 2009).

Following preprocessing, the study selects Gower Distance as the clustering algorithm, suitable for datasets containing both numeric and categorical variables (Landau & Chis Ster, 2010).

Data Sources

The data comprise primary and secondary sources:

Tabel 1. Data Source

Data Type	Variables	Source
Primary Data	Tomb profile data	Field measurement
	Tombstone and platform dimensions	
	Tomb decoration characteristics	
	Tomb material types	
Secondary Data	Tomb location data	Cultural Heritage Agency

Source: Author's Analysis, 2023

The study population includes ancient Islamic tombs located across cities and regencies in Jambi Province. Based on preliminary observations, previous journal publications, and interviews with the Expert Team for Cultural Heritage of Sungai Penuh City, Islamic tombs are distributed in Jambi City, Kerinci Regency, Tebo Regency, Sarolangun Regency, and East Tanjung Jabung Regency (Izza, Adi, et al., 2021; Putra, 2019; Setia, 2022; Sunliensyar, 2016). A purposive sampling technique is applied, which involves selecting samples based on specific research purposes (Wijaya et al., 2024). This study examines 50 samples of ancient Islamic tombs located in two selected sites: Jambi City and Kerinci Regency.

RESULTS AND DISCUSSION

The relationship between the regions of ancient Islamic tombs in Jambi and three main variables—tomb decoration, tombstone decoration, and material—was examined using the

Chi-Square test. This bivariate statistical analysis aims to identify whether there are significant associations between these categorical variables based on regional differences. The variables were grouped accordingly, and the analysis was conducted at a 5% significance level ($\alpha = 0.05$). The Chi-Square test helps determine whether the observed variations in tomb characteristics are influenced by geographic location. Cross-tabulated data for each variable are presented in the tables below for further interpretation.

1. Tomb Decoration

Based on the results of the study, the relationship between the region of ancient Islamic tombs and their decorative features can be observed through the Chi-Square test results shown in Table 2.

Table 2. Relationship Between Region and Tomb Decoration

Decoration Type	Floris	Frequency	Region		Total	p-value
			Kerinci	Jambi City		
	Floris	Frequency	2	3	5	0.008
		%	40.0%	60.0%	100.0%	
	Geometric	Frequency	5	10	15	
		%	33.3%	66.7%	100.0%	
	Calligraphy	Frequency	6	2	8	
		%	75.0%	25.0%	100.0%	
	Mixed	Frequency	1	1	2	
		%	50.0%	50.0%	100.0%	
	None	Frequency	18	2	20	
		%	90.0%	10.0%	100.0%	
	Total	Frequency	32	18	50	
		%	64.0%	36.0%	100.0%	

Source: Primary Data, 2025

The examination of cross-tabulated data between geographic regions and decorative characteristics of early Islamic tombs in Jambi reveals that 20 out of the 50 analyzed tombs lacked any form of ornamentation. This suggests a prevailing traditional aesthetic in certain regions, where tombs remain undecorated and simplistic in style. A Chi-Square analysis generated a p-value of 0.008 ($p < 0.05$), signifying that the null hypothesis, stating no association between regional setting and decorative style, can be rejected. Instead, a significant link was found, indicating that the tomb decoration types are influenced by their respective geographic contexts in Jambi.

The cross-tabulation table further demonstrates this pattern: in Kerinci, 18 out of 32 tombs (56.3%) were undecorated, while only 2 out of 18 tombs (11.1%) in Jambi City shared that characteristic. Conversely, geometrical and floral decorations were more frequent in Jambi City, appearing in 10 and 3 tombs respectively, compared to 5 and 2 in Kerinci. This distribution reinforces the inference that tomb decoration practices are not equally distributed but rather influenced by localized sociocultural dynamics. The relatively high number of calligraphic tombs in Kerinci (6 of 8 total) suggests unique cultural-religious expressions specific to the highland communities, possibly linked to mystical Islamic traditions.

This conclusion is consistent with the findings of Wuri Handoko (2020), who pointed out that tomb aesthetics and design serve not only ritualistic purposes but also function as markers of cultural identity, economic condition, and lingering pre-Islamic traditions. Regions such as Kerinci, known for their cultural conservatism and relative isolation, typically feature tombs with minimal or no decoration. Conversely, in areas like Jambi City, where Islamic influence

and trade networks were established earlier, a broader array of decorative styles—including geometric, floral, and calligraphic elements—is present.

The lack of ornamentation may correspond to Islamic teachings on humility and monotheism. Yet, Uka Tjandrasmita (2022) emphasizes that this aesthetic choice may also reflect a continuation of pre-Islamic, megalithic spiritual traditions that prioritize symbolic function over visual form. In the context of Nusantara Islamic art, floral and geometric motifs often represent cultural syncretism, blending Islamic elements with indigenous or older Hindu-Buddhist artistic practices.

Arabic script used decoratively on tombstones is commonly tied to Islamic scholarship and religious institutions such as pesantren. Pinem (2018) notes that calligraphy on tombs conveys spiritual messages and functions as both religious and aesthetic expression—often comprising prayers or moral reflections. Tombs featuring such inscriptions are typically associated with religious authorities or culturally esteemed individuals.

From a quantitative standpoint, geometric and floral motifs, accounting for 15 and 5 tombs respectively, are more commonly found in Jambi City, comprising 66.7% and 60% of those categories. In contrast, Arabic calligraphy appears in 75% of the tombs located in Kerinci, suggesting that localized religious practices such as those linked to Sufi traditions play a role in shaping tomb aesthetics in this region.

These findings resonate with theories of cultural adaptation proposed by Donny Khoirul Aziz (2019), who argues that Islamic mortuary art often emerges through a negotiation between religious orthodoxy and local customs. In Jambi, this is exemplified by the presence of tombs with hybrid stylistic traits found in both rural and urban areas.

The link between decorative features and the social status of the deceased also warrants attention. As discussed in Purnamasari et.al (2021) ornate tombs often serve as visual markers of economic, spiritual, or political status. Thus, decorative richness frequently corresponds with individuals of elevated societal positions such as scholars, nobility, or affluent merchants.

These results also contribute to broader understandings of Islamization processes in Indonesia, emphasizing their heterogeneous nature. Tomb design choices in different parts of Jambi reflect distinct levels of engagement with external Islamic norms, local religious developments, and cultural resilience.

Moreover, comparative research with other Indonesian regions such as Aceh, West Sumatra, and Palembang, highlights that tomb decoration can serve as a tool for political narrative and legitimacy. Royal tombs in Aceh, adorned with Persian-inspired floral motifs and calligraphy, reveal connections to transregional Islamic cultures. Meanwhile, West Sumatran tombs often integrate Minangkabau carving motifs within Islamic forms. In contrast, the prevalence of undecorated tombs in areas like Kerinci indicates a more insular and spiritually minimalist approach, potentially influenced by local Sufi traditions and community-based religious leadership. Uka Tjandrasmita provides further insights into how local clerics and mystic orders shaped the religious material landscape of Islamic graves.

Through a combination of quantitative data analysis and cultural interpretation, this study underscores that Islamic tombs in Jambi are not merely burial sites, but serve as cultural texts embodying historical, religious, and social narratives. The empirical results not only reinforce existing interpretations but also encourage further inquiry into the diverse expressions of Islamic material culture within Indonesian archaeology.

2. Tombstone Shapes

The study explored how the regional distribution of early Islamic tombs in Jambi correlates with the form of their tombstones. This relationship was examined through a Chi-

Square statistical test. Table 3 presents the outcome of this analysis, showing a significant association between regional variation and tombstone shapes.

Table 3. Relationship Between Region and Tombstone Shape

		Region		Total	p-value
		Kerinci	Jambi City		
Tombstone Shape	Gada	Frequency	3	8	0.005
		%	27.3%	72.7%	
	Pipih	Frequency	0	1	
		%	0.0%	100.0%	
	None	Frequency	29	9	
		%	76.3%	23.7%	
Total	Frequency	32	18		
	%	64.0%	36.0%		

Source: Primary Data, 2025

Table 3 show that highlights a meaningful connection between geographic locality and the formal characteristics of Islamic tombstones in Jambi. The data derived from 50 recorded graves distributed across Kerinci and Kota Jambi exhibits three primary tombstone types: Gada (club-shaped), Pipih (flat), and None (no tombstone).

The most striking trend is the overwhelming presence of flat (pipih) tombstones in Kerinci, comprising 29 out of the 32 graves (90.6%) in the region. Conversely, gada-shaped tombstones dominate in Kota Jambi, appearing in 8 out of 18 cases (44.4%). The Chi-Square test result ($p = 0.005$) confirms a statistically significant association between region and tombstone shape, suggesting that cultural, environmental, and religious factors are at play in shaping local mortuary traditions.

Flat tombstones in Kerinci are likely influenced by local availability of stone, traditional megalithic practices, and a strong Sufi-Islamic identity that favors minimalism. This is consistent with insights from Tjandrasmita (2022) where Islamic adaptations of earlier local traditions created hybrid mortuary forms. The integration of pre-Islamic symbolic norms into Islamic burial rituals is particularly evident in isolated highland communities such as Kerinci, which maintained older belief systems longer due to geographic separation.

The prevalence of gada-shaped markers in Kota Jambi, on the other hand, reflects a more urbanized, centralized Islamic culture, with greater exposure to maritime trade, textual Islam, and aesthetic influences from other parts of the archipelago and Islamic world. Uka Tjandrasmita notes similar findings in Aceh and North Sumatra, where Islamic grave aesthetics correlate with patterns of trade and clerical networks.

The single tomb without a clear tombstone in Kota Jambi might reflect either a degraded archaeological feature or an intentional absence due to spiritual or economic reasons. This aligns with the findings in nanang and endang (2019), which discuss variations in tomb typology as reflective of both social class and theological emphasis. For some communities, anonymity in death may be a virtue rather than a limitation.

The data suggest that Kerinci exhibits a stronger continuity with indigenous mortuary architecture, where flat stones are part of a longstanding material culture extending from megalithic grave markers. In contrast, Kota Jambi's vertical forms may symbolize a greater aspiration toward visibility and religious orthodoxy. This pattern echoes the themes of cultural adaptation explored by Donny Khoirul Aziz (2019), who argues that Islam in Indonesia was locally negotiated through both elite patronage and grassroots appropriation.

Moreover, the influence of Minangkabau and Malay traditions likely played a role in shaping the formal expression of tombs in both regions. Kerinci's flat tombs may mirror Minangkabau burial customs that stress humility, whereas the prominence of gada-shaped stones in Kota Jambi could correspond with symbols of authority and power, a feature often highlighted in the *Clustering_Methods.pdf* and *Candii dan Konteks.pdf*, which both suggest a link between verticality in architecture and elite status.

Archaeologically, such distinctions point to a layered cultural memory embedded in funerary landscapes. As Aldenderfer (1998) explains, quantifying form variation through Chi-Square or cluster analysis enables archaeologists to decode symbolic practices that were otherwise treated narratively. In this context, the statistical result provides strong support for the argument that tomb forms are regionally differentiated in a way that reflects distinct social, environmental, and spiritual conditions.

In summary, the data from Table 3 underscores the vital role of region in determining tombstone morphology. In Kerinci, flat stones dominate as expressions of cultural continuity, resource availability, and a modest Sufi-influenced worldview. In Kota Jambi, the more varied presence of gada and other markers speaks to complex interactions between social class, Islamization processes, and exposure to transregional influences. The use of statistical tests enriches the interpretative potential and underscores the need for further regional comparisons within Islamic archaeology in Indonesia.

3. Tomb Construction Materials

Based on the research findings, the relationship between the region of early Islamic graves and the materials used in tomb construction was analyzed using a Chi-Square test. Table 4 presents the results, indicating no statistically significant association. Materials like stone, wood, and cement reflect practical and regional availability.

Table 4. Relationship Between Region and Tomb Construction Material

Material			Region			p-value
			Kerinci	Jambi City	Total	
Stone	Frequency		10	5	15	0.161
	%		66.7%	33.3%	100.0%	
Wood	Frequency		8	9	17	
	%		47.1%	52.9%	100.0%	
Cement	Frequency		14	4	18	
	%		77.8%	22.2%	100.0%	
Total	Frequency		32	18	50	
	%		64.0%	36.0%	100.0%	

Source: Primary Data, 2025

The cross-tabulation between region and tomb material reveals that 18 out of 50 tombs were constructed using cement. The Chi-Square test produced a p-value of 0.161, which is greater than the significance level $\alpha = 0.05$. This means the null hypothesis (H_0 : material type and region are independent) is accepted, while the alternative hypothesis (H_1 : material type and region are dependent) is rejected. Statistically, this confirms that no significant relationship exists between the region and the material used in Islamic tombs in Jambi Province.

The implications of this result point to a practical, rather than cultural or religious, basis for the selection of tomb materials. In regions like Kerinci, material choices appear to be driven by environmental availability and traditional building knowledge. Natural stones are more accessible in highland terrains, which makes their usage both logical and sustainable. Wooden

tombs are also prevalent, signifying the use of local forestry products and artisanal practices that have persisted over generations.

Interestingly, the high frequency of cement-based tombs, especially in Kerinci, may not necessarily reflect original mortuary preferences, but instead the result of restoration efforts. As noted in Wuri (2014) the use of modern materials like cement often indicates maintenance or refurbishment rather than original construction. This implies a dynamic cultural landscape, where traditional practices are supplemented by contemporary techniques, sometimes without disrupting core ritual or symbolic values.

According to Uka Tjandrasmita (2022) in *Arkeologi Islam Nusantara*, the choice of tomb material often reflects more than just function; it encapsulates the interaction between faith, economy, and environment. Cement, while not traditional, has become increasingly common in restoration efforts due to its durability and affordability. This is particularly relevant in Islamic grave maintenance, where family members may choose to reinforce old structures using modern materials while maintaining the original shape or layout.

In terms of symbolic values, materials like stone are often associated with endurance and spiritual weight, which may relate to the perception of permanence in the afterlife. Wood, on the other hand, could symbolize humility and natural return, consistent with Islamic ideas about modesty in death. Nanang and Endang (2019) also supports this view, explaining that in many Islamic communities, simple graves are preferred as a reflection of equality before God.

Furthermore, Nurhadi (1995) explains that in many Indonesian contexts, the construction of tombs is not only a family obligation but a social act influenced by communal norms. This might lead to standardization in tomb construction, reducing variation even across geographically or culturally distinct areas.

The data also raise interesting questions about the role of modernization in Islamic burial practices. As shown in Anuraga et al. (2018), Islamic burial sites often evolve over time, incorporating new materials and techniques as part of living traditions. Therefore, the use of cement in both rural and urban settings can be seen as a form of continuity through transformation, not as a rupture with tradition.

This perspective aligns with arguments presented in Aldenderfer (1998), which advocates for interpreting material data not just through typology, but through contextual analysis that considers temporal dynamics and cultural fluidity. The use of modern materials in ancient burial sites is a case in point: it reflects both change and persistence, influenced by current socio-economic realities, environmental access, and the evolving aesthetic values of the communities involved.

In conclusion, while the Chi-Square test shows no statistical association between material type and geographic location, the broader archaeological and cultural context reveals a more nuanced picture. Material choice in early Islamic tombs in Jambi is best understood as a complex interplay of geography, tradition, restoration needs, and evolving cultural norms. Cement may reflect repair rather than original intent; wood and stone reflect availability and cultural symbolism. This finding reinforces the importance of integrating statistical results with ethnographic and historical interpretation to fully understand Islamic material culture in Indonesia.

3. Analysis of Clustering

This study also applies cluster analysis to examine the classification of early Islamic tombs in Jambi based on multiple attributes, including tombstone shape, material, inscriptions, orientation, and geographical location. Cluster analysis is a statistical method used to group

similar data points based on shared characteristics. In archaeological research, it is particularly effective for identifying patterns and cultural variations across spatial and temporal contexts.

In the case of 50 tombs analyzed from Kerinci and Kota Jambi, a hierarchical cluster analysis was employed, producing a dendrogram (see Figure 1). In this dendrogram, the horizontal axis represents individual tombs, while the vertical axis measures the degree of dissimilarity or "distance" between them. Tombs that are grouped together at a lower vertical height are more similar to one another in terms of their recorded attributes. A red dashed line is used as a cut-off point to divide the data into a distinct number of clusters, resulting in five main groupings.

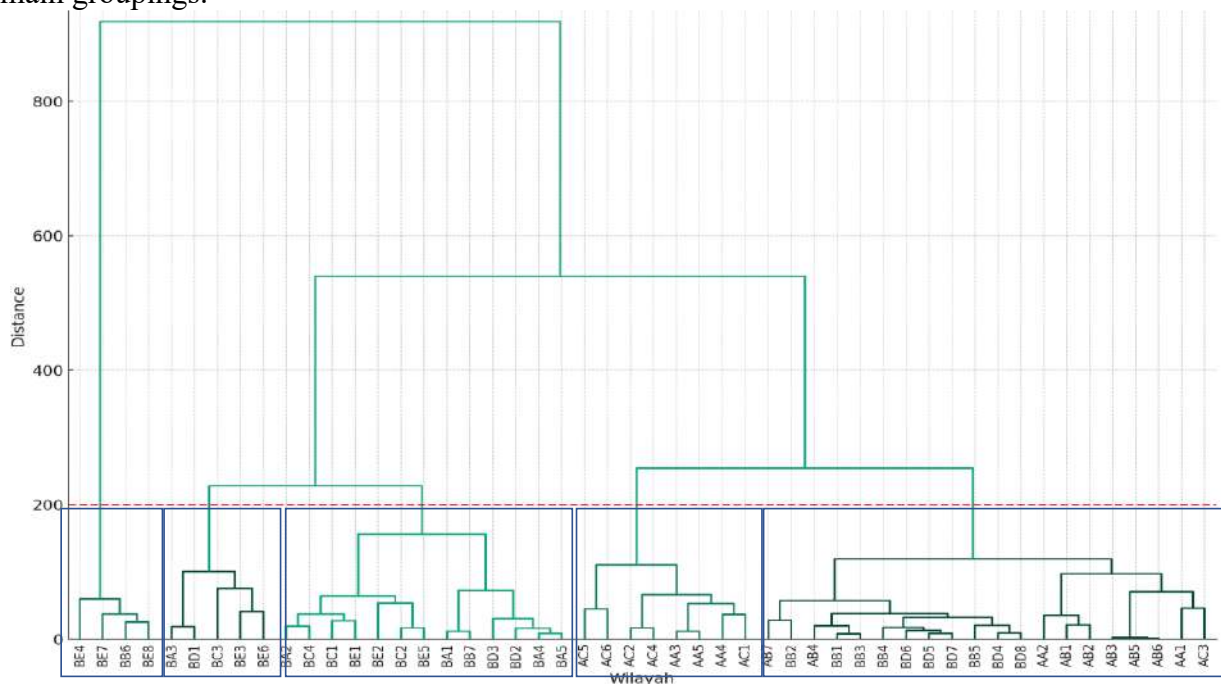


Figure 1. Dendrogram of Early Islamic Tombs in Jambi
Source: Primary Data, 2025

Code	Region	District
AA	Kota Jambi	Seberang
AB	Kota Jambi	Legok
AC	Kota Jambi	Sungai Putri
BA	Kerinci	Sungai Bengkal
BB	Kerinci	Sungai Penuh
BC	Kerinci	Pesisir Bukit
BD	Kerinci	Air Hangat Timur
BE	Kerinci	Keliling Danau

The cluster analysis identifies five distinct groups, suggesting a diversity of mortuary practices influenced by geography, culture, and historical transitions. Each group shares similar architectural, material, and symbolic features, implying that certain communities followed standardized burial customs. These clusters offer insights into local traditions, regional adaptations, and social structures.

For instance, one group predominantly features tombs with flat stones and minimal ornamentation, aligning with Sufi or modest Islamic practices described in Nanang and Endang and supported by Tjandrasmita’s discussion in *Arkeologi Islam Nusantara*. Another cluster may consist of tombs using cement and decorative forms such as Gada-shaped stones, possibly indicating restored graves or higher-status individuals.

According to *Aldenderfer (1998)*, such classification can be used to infer broader socio-cultural processes, including migration, Islamic expansion, and local adaptation. The use of clustering helps move beyond individual descriptions toward identifying structural regularities in the dataset.

Furthermore, this approach aligns with the methodology recommended by *Anuraga et al.* in analyzing cultural variation using mixed data types. The application of Gower distance, a technique that allows for clustering on mixed numerical and categorical data, enhances the accuracy of interpretation. It acknowledges the hybrid nature of archaeological data, especially in sites like Jambi where tomb attributes combine local and Islamic influences.

The five resulting clusters can be interpreted as reflecting different phases or influences in the Islamization process. Some may represent early Islamic graves influenced by local animist or megalithic traditions, while others show integration with broader Islamic networks, possibly via trade routes. These groupings highlight how tomb attributes act as proxies for cultural, spiritual, and economic shifts across time.

Cluster analysis also enables comparative archaeology by linking Jambi's Islamic mortuary data to patterns observed in other regions such as Aceh, West Sumatra, and Kalimantan. As shown in *Nurhadi (1995)* regional tomb variation often mirrors differences in religious authority, material access, and patronage networks.

In conclusion, the dendrogram in Figure 1 serves not just as a visual classification tool but as an interpretive framework to understand the dynamic and pluralistic nature of Islamic funerary culture in Jambi. By applying quantitative methods in tandem with historical and ethnographic insight, this study contributes to a more nuanced, interdisciplinary understanding of Islamic archaeology in Indonesia.

The dendrogram provides valuable insights into burial traditions in Jambi. The resulting five groups reflect variations in cultural practices, environmental adaptation, and technological responses. Below, Table 5 and Table 6 illustrate the characteristics of tombstones and grave dimensions for each group.

Table 5. Average Tombstone Attributes by Cluster

Cluster	Length (cm)	Height (cm)	Diameter (cm)	Width (cm)	Modal Shape
1	25.5	34.5	6.8	33.75	Plat
2	34.2	36	5	56.4	Plat
3	23.3	26.6	1.9	34.6	Plat
4	14.2	71.8	23.5	2.2	Gada
5	30.3	30.7	2.05	26.8	Plat

Source: Primary Data, 2025

Table 6. Average Grave Structure Attributes by Cluster

Cluster	Modal Decoration	Length (cm)	Width (cm)	Height (cm)	Modal Material
1	None	470	385	180	Wood
2	None	330	197	80.8	Cement
3	None	290.6	156.7	39.2	Cement
4	Geometric	174	79.6	70.7	Stone
5	Geometric	181.7	79.8	27.4	Wood

Source: Primary Data, 2025

Clusters 1–3 show a dominant use of flat tombstones with natural materials like wood and stone, minimal decoration, and larger grave structures. These attributes resonate with locally rooted burial customs described by Asril et al. (2024), suggesting continuity of tradition and strong ties to local environments. In contrast, Clusters 4 and 5 feature Gada-shaped tombstones and geometric decoration, marking a shift in aesthetic or ideological influences and indicating potential status distinctions or religious reinterpretation.

The diversity captured in the clustering confirms the adaptability of Islamic funerary practices to both environmental constraints and external cultural influences. The use of cement in Clusters 2 and 3, for example, may suggest recent refurbishments, echoing notes in Wuri, rather than original construction. Meanwhile, Cluster 4's emphasis on verticality and stone-based ornamentation might represent the incorporation of prestige indicators, akin to findings in Nurhadi (1995) regarding monumentalism in Sumatra.

These interpretations are further reinforced by Aldenderfer's (1998) methodological emphasis on multi-attribute classification and cultural processualism. The patterns seen in Jambi align with broader Southeast Asian Islamic mortuary trajectories, where material constraints, spiritual ideology, and political networks shape burial diversity.

Ultimately, the cluster analysis affirms the co-existence of traditional and modern elements in Jambi's Islamic burial landscape. Some clusters reflect heritage-based conservatism; others reveal stylistic evolution. By integrating statistical pattern recognition with ethnographic knowledge, this section underscores that tombs are not merely remnants of death but repositories of evolving Islamic identities.

The combination of statistical clustering with cultural interpretation provides a methodological advancement for Islamic archaeology in Southeast Asia. It builds upon earlier qualitative works by Uka Tjandrasmita and complements local ethnographic observations from Nanang and Endang. Moreover, the quantitative distinctions in material, shape, and size inform not only the spatial differentiation of burial sites but also potential diachronic changes in burial ideology.

The presence of flat tombstones in early clusters coincides with evidence of modest Islamic practices, perhaps aligned with early Sufi influences in Sumatra, while the emergence of more complex geometric patterns and cement structures in later clusters could point to increased external influences, socio-economic stratification, or state involvement in funerary expressions. This duality between continuity and change, captured through cluster analysis, resonates with broader cultural adaptation theories discussed by Hasanah (2023), where tradition and innovation operate concurrently in the formation of religious material culture.

In addition, the statistical outputs support broader hypotheses about Islamic expansion and its localizations. By correlating clusters with spatial data, future research may explore whether certain tomb clusters are more prevalent in trade-rich areas, near river networks, or within royal settlement zones. This perspective aligns with the multi-scalar analysis approach in archaeological landscape studies, which situates burial data within broader socio-political and economic ecologies.

Thus, the cluster analysis does more than classify, it provides a nuanced entry point into understanding how Islam was adopted, adapted, and expressed materially across different communities in Jambi. It also invites further interdisciplinary exploration, combining archaeological typologies, historical linguistics, spatial GIS analysis, and Islamic theological evolution to construct a layered narrative of religious materiality in the Malay-Indonesian world.

CONCLUSION

This study demonstrates the effectiveness of combining archaeological field data with quantitative statistical analysis to better understand Islamic funerary practices in the Jambi region. Using descriptive statistics, Chi-square analysis, and hierarchical clustering, the study revealed significant relationships between tomb attributes—such as shape, decoration, and construction material—and their geographical distribution.

The findings indicate that pipih (flat) tombstones made from local stone are dominant in the Kerinci region, suggesting that indigenous cultural values and resource availability significantly influenced funerary practices. Conversely, tombs located in Kota Jambi exhibit more variation, including the use of gada-shaped stones and ornamental elements such as geometric carvings and inscriptions. These differences reflect not only regional cultural diversity but also varying levels of socio-economic stratification and potential shifts in religious or political influence over time.

The application of cluster analysis has proven especially valuable, offering a clearer framework for classifying graves into distinct groups based on shared physical characteristics. The five clusters identified illustrate a spectrum of burial styles, from traditional and locally rooted forms using natural materials (e.g., stone and wood) to more contemporary or revitalized forms incorporating cement and geometric ornamentation. This pattern reflects a dynamic interaction between continuity and innovation, grounded in both environmental adaptation and evolving aesthetic or religious ideals.

Furthermore, the integration of statistical clustering with archaeological typology provides a robust model for future studies in Islamic archaeology, especially within the Indonesian and broader Southeast Asian contexts. It highlights the potential of interdisciplinary methodologies, combining material analysis, cultural theory, and spatial data interpretation, to produce more nuanced understandings of historical identity formation and mortuary behavior.

The insights drawn from this study also have practical relevance. For cultural heritage managers and policymakers, identifying the material and stylistic evolution of Islamic graves can guide more context-sensitive conservation strategies. For archaeologists, the study offers a replicable model for analyzing Islamic burial sites elsewhere using quantitative approaches. For scholars of Islamic studies and anthropology, it opens a window into how Islamic traditions were localized and transformed in the Indonesian archipelago.

Ultimately, this research contributes to a deeper understanding of the Islamic cultural landscape in Jambi and illustrates the value of bridging qualitative tradition with quantitative rigor. By analyzing material remains with scientific precision while contextualizing them within broader socio-cultural frameworks, the study offers a multidimensional view of how Islamic mortuary culture developed, persisted, and diversified across space and time.

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