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Romania

*CORRESPONDENCE

Helen Hernandez Cordova
✉ hhernandezc@unemi.edu.ec

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Higher education and occupational differentiation in the Ecuadorian armed forces: a pre-reform baseline analysis using the 2022 national employment survey (ENEMDU)

Helen Hernandez Cordova^{1*}, Efstathios Stefos²,
Mario Manuel Cardenas Rodríguez³,
Iván Arturo Ramirez Sanchez³ and Enrique Ferruzola-Gomez³

¹Facultad de Ciencias Sociales, Educación Comercial y Derecho, Universidad Estatal de Milagro, Milagro, Ecuador, ²Carrera de Educación Básica, Universidad Nacional de Educación, Azogues, Ecuador, ³Facultad de Ciencias Agrarias, Universidad Agraria del Ecuador, Guayaquil, Ecuador

Introduction: The 2023 Organic Law on Personnel and Discipline of the Armed Forces strengthened the connection between military education and Ecuador national higher education system. Despite the policy relevance of this reform, little quantitative evidence describes the educational and occupational structure of the Armed Forces immediately before its implementation. This study establishes a pre-reform baseline using the 2022 National Survey of Employment, Unemployment, and Underemployment (ENEMDU). Because the survey predates the law, the analysis does not estimate its effects.

Methods: The study used data from the 2022 ENEMDU, a nationally representative household labor force survey produced by the National Institute of Statistics and Censuses of Ecuador. The analytical group included 528 interviewed respondents classified in Armed Forces occupations, representing 29,207 persons after application of survey weights. The analysis combined weighted descriptive statistics and multiple correspondence analysis as the primary analytical approaches, supplemented by exploratory Ward hierarchical clustering, to examine educational, sociodemographic, labor market, and occupational differentiation.

Results: The results showed a predominantly male, married or common-law, and mestizo occupational group, with substantial internal differentiation by education, income, age, and occupational category. University or postgraduate education accounted for 32.4% of the weighted group, whereas secondary or middle education accounted for 49.0%. Adequate or full employment reached 99.4% in the Armed Forces occupational group, compared with 31.1% in the general Ecuadorian population aged 22–63. Multiple correspondence analysis identified structured associations among education, income, age, sex, marital status, and ethnic self-identification. Exploratory clustering further illustrated internal heterogeneity, although cluster membership became less stable when additional MCA dimensions were retained.

Discussion: These findings document the educational and occupational structure from which future post-reform evaluations may proceed. At the same time, the results should be interpreted as descriptive because household survey data cannot directly measure military branch, school, rank trajectories, promotion pathways, or training content.

KEYWORDS

Armed Forces, Ecuador, higher education, military education, occupational differentiation, national employment survey, multiple correspondence analysis, hierarchical clustering

1 Introduction

The Ecuadorian Armed Forces occupy a central place in debates on sovereignty, security, and state formation. In Ecuador, as in much of Latin America, the military institution has also been part of broader discussions on citizenship, public order, and civil-military relations (Jiménez Villarreal and Franchi, 2020; Polga-Hecimovich, 2023; Saltos, 2017). Changes in military education are therefore not only internal organizational matters. They also affect how the institution is positioned within the national higher education system and within the social structure.

A relevant legal change is the Organic Law on Personnel and Discipline of the Armed Forces, approved in 2023. The law reorganizes the military career structure, regulates personnel in training and active service, and strengthens the connection between military education and the national higher education system (*Ley Organica de Personal y Disciplina de las Fuerzas Armadas*, 2023). Its regulatory framework further defines military specialization and higher specialization and specifies that training institutions linked to the Armed Forces must operate in coordination with the broader higher education order (*Reglamento General a la Ley Organica de Personal y Disciplina de las Fuerzas Armadas*, 2023).

This legal shift places Ecuador within a wider international discussion on the academization of professional military education. Recent work has emphasized that military education increasingly intersects with university standards, accreditation systems, civilian faculty participation, and broader debates on professional expertise (Free, 2026; Hedlund, 2019; Lacquement, 2022; Libel and Ateş, 2025; Powell and Townley, 2025). Military sociology has also shown that armed forces are shaped by social hierarchies, political institutions, occupational identities, and the internal distribution of authority and credentials (Pinillos, 2007; Starčević and Blagojević, 2021).

The present article uses the language of professionalization cautiously. In its full institutional meaning, military professionalization involves branch, rank, command responsibility, promotion systems, military school, specialization, years of service, training trajectory, doctrine, and professional norms. The national labor-force survey used in this article is not designed to observe most of those dimensions. It records completed education, labor income, broad occupational categories, and sociodemographic characteristics. The empirical object of this article is therefore not professionalization as a complete institutional process, but educational and occupational differentiation within an Armed Forces occupational group before a major legal reform.

This distinction matters because the 2023 reform did not emerge over an empty institutional landscape. It intervened in a field that already had internal educational and occupational differentiation. Understanding that pre-reform structure is important because future evaluations of the law require a clear baseline against which subsequent changes can be assessed. Existing discussions have described institutional change and military education models, but there is still limited quantitative evidence on the social and educational profile of the population classified in the Armed Forces occupational group in national survey data (Muñoz Gualán, 2020).

Three questions guide the analysis. First, what sociodemographic and educational profile characterized the Ecuadorian Armed Forces occupational group in 2022? Second, how are age, sex, educational level, income, marital status, and ethnic self-identification associated within that group, and what patterns of internal differentiation emerge from those associations? Third, how does the Armed Forces occupational group compare with the general Ecuadorian population of the same age range on basic labor-market indicators?

The study contributes a quantitative baseline of educational and occupational differentiation within the Ecuadorian Armed Forces immediately before a major legal reform. It does not claim that the 2022 survey captures the effect of the 2023 law. Instead, it provides an empirical reference point for future work using later rounds of the same survey or administrative military education data. In that sense, the article connects legal change, higher education policy, and occupational structure without making causal claims that the available data cannot support.

2 Materials and methods

This study uses the individual respondent file of the 2022 National Survey of Employment, Unemployment, and Underemployment (Encuesta Nacional de Empleo, Desempleo y Subempleo, ENEMDU), produced by the National Institute of Statistics and Censuses of Ecuador (INEC) (*Instituto Nacional de Estadística y Censos*, 2022). ENEMDU is a national household labor-force survey that collects information on employment, income, education, and sociodemographic characteristics. The household and housing files were not required for the present analysis because all variables used here are available in the individual respondent file.

The analytical group was identified from the official occupational classification used in the survey. Respondents were included when their occupation was classified as an Armed Forces occupation. The exact survey variable, occupational code,

and category labels used for this classification are reported in [Supplementary Appendix Table A1](#) to facilitate replication. The more detailed occupation field distinguishes three broad Armed Forces occupational categories: commissioned officers, noncommissioned officers, and other Armed Forces ranks ([International Labour Organization, 2012](#)). These labels are survey occupational classifications rather than administrative military rank records, and they are distinct from the exploratory clusters estimated later in the article.

The core variables are sex, age, marital status, educational level, ethnic self-identification, monthly labor income, employment condition, work arrangement, detailed Armed Forces occupational category, and years in the current job. The exact ENEMDU field names, occupational codes, and variable descriptions used to construct these measures are reported in [Supplementary Appendix Table A1](#). Age was grouped into 22–30, 31–40, 41–50, and 51–63 years. The comparison with the general Ecuadorian population is restricted to ages 22–63 to avoid distortions arising from children, adolescents, and older adults outside the age range observed in the Armed Forces occupational group.

All weighted estimates use the ENEMDU expansion factor variable (*fexp*), which allows interviewed respondents to be expanded to national population estimates. Weighted population counts and percentages were calculated using the ENEMDU expansion factor, while unweighted respondent counts are reported separately as *n*. [Table 1](#) reports interviewed respondent counts (*n*), weighted population estimates (*N*), and weighted percentages (%), allowing direct comparison between the survey sample and the corresponding population estimates. The analytical group includes 528 interviewed respondents, representing 29,207 persons after application of the ENEMDU survey weights. [Table 2](#) reports both interviewed respondents and weighted population estimates for the labor-market benchmark so that weighted population totals are not confused with the number of interviewed cases.

For monthly labor income, responses coded as nonresponse in the ENEMDU dataset were treated as missing. Four interviewed Armed Forces respondents had missing income information, representing 85 weighted persons, or 0.3% of the weighted group. These cases are reported as a separate missing-income category in [Table 1](#) but were excluded from the multiple correspondence analysis and hierarchical clustering because those methods require valid categories for all active variables. No additional imputation procedures were applied.

Multiple correspondence analysis (MCA) was used to describe how categorical variables are associated with one another. MCA is appropriate because the analysis includes categorical measures such as age group, educational level, ethnic self-identification, marital status, sex, and income bracket. To reduce instability arising from sparse categories, the MCA used collapsed categories for marital status (married/common-law, single, other marital status), education (secondary/middle, non-university higher, university higher, postgraduate), ethnic self-identification (mestizo, Afro-Ecuadorian/Black/Mulatto, indigenous, other ethnicity), and income (up to USD 1,000, USD 1,001–2,000, USD 2,001–3,000, and more than USD 3,000). Sex and age group were retained as described above. The MCA complete-case analytical set contained 524 interviewed respondents, representing 29,122 weighted persons. Detailed Armed Forces occupational category and years in the current job were not

active variables in the MCA or clustering procedure; they were used only to describe the resulting exploratory clusters.

The MCA was estimated from a category-indicator matrix in which each row represents a respondent and each column represents a response category. Survey weights were incorporated as row masses proportional to the ENEMDU expansion factor (*fexp*), so that the results describe the weighted population estimate rather than only the interviewed respondents with complete information. The results report eigenvalues and inertia, which summarize how much of the association structure is represented by each MCA dimension. [Supplementary Appendix](#) materials additionally report category coordinates, contributions, and squared cosine values for the first three dimensions. The axes are interpreted as dimensions of association rather than causal effects ([Fithian and Josse, 2017](#); [Parra Olivares, 1996](#)).

Because the first three MCA dimensions accounted for 33.0% of total inertia, a sensitivity analysis examined whether the clustering results depended on the number of retained dimensions. Ward clustering was re-estimated using the first four, five, and six MCA dimensions, which accounted for 41.2%, 48.4%, and 55.5% of cumulative inertia, respectively. Agreement with the primary three-dimensional solution was evaluated using the adjusted Rand index ([Hubert and Arabie, 1985](#)) and weighted classification agreement after optimal relabeling of the clusters. Given the modest number of complete cases and the sensitivity of the smaller clusters to the number of retained dimensions, hierarchical clustering is treated as a secondary exploratory analysis. The principal conclusions of the study are based on the weighted descriptive results and the MCA association structure rather than on cluster membership.

Hierarchical clustering was then applied to respondent coordinates on the first three MCA dimensions. Euclidean distances and Ward minimum-variance linkage were used ([Ward, 1963](#)). Ward clustering is a standard hierarchical method that forms groups by minimizing within-group variation. The MCA coordinates were used directly in the clustering procedure without additional standardization. Candidate solutions ranging from two to six clusters were evaluated using the average silhouette ([Rousseeuw, 1987](#)), Calinski-Harabasz ([Caliński and Harabasz, 1974](#)), and Davies-Bouldin ([Davies and Bouldin, 1979](#)) indices. Higher average silhouette and Calinski-Harabasz values, together with lower Davies-Bouldin values, generally indicate stronger separation between clusters. The retained cluster solution is exploratory and is used only to summarize patterns of internal differentiation observed in the MCA space. It should not be interpreted as evidence of stable or naturally occurring institutional subgroups.

All data management, descriptive analyses, multiple correspondence analyses, hierarchical clustering procedures, and figure production were conducted in R ([R Core Team, 2025](#)). Data preparation and descriptive statistics used functions from the tidyverse ecosystem ([Wickham et al., 2019](#)). Multiple correspondence analysis was implemented using FactoMineR ([Lê et al., 2008](#)), while cluster validation statistics and hierarchical clustering procedures were computed using standard clustering functions available in R. The analytical workflow was designed to ensure full reproducibility from the publicly available ENEMDU data files and the variable definitions reported in [Supplementary Appendix Table A1](#).

All results are descriptive, cross-sectional, and pre-reform. ENEMDU is a household survey rather than an

TABLE 1 Sociodemographic, educational, occupational, and income profile of the armed forces occupational group, ENEMDU 2022.

Measure	Category	Interviewed <i>n</i>	Weighted <i>N</i>	Weighted %
Detailed occupational category	Commissioned officers	77	3,386	11.6
	Noncommissioned officers	447	25,425	87.0
	Other Armed Forces ranks	4	396	1.4
Sex	Men	501	27,634	94.6
	Women	27	1,573	5.4
Age	22–30 years	109	6,202	21.2
	31–40 years	237	11,986	41.0
	41–50 years	157	9,751	33.4
	51–63 years	25	1,268	4.3
Marital status	Married	420	23,372	80.0
	Common-law union	53	3,086	10.6
	Single	35	1,845	6.3
	Separated	10	603	2.1
	Divorced	9	268	0.9
	Widowed	1	34	0.1
Educational level	Secondary education	235	13,845	47.4
	Middle education	14	478	1.6
	Non-university higher education	100	5,416	18.5
	University higher education	140	7,926	27.1
	Postgraduate education	39	1,542	5.3
Ethnic self-identification	Indigenous	17	432	1.5
	Afro-Ecuadorian	19	1,229	4.2
	Black	5	239	0.8
	Mulatto	3	125	0.4
	Montuvio	2	144	0.5
	Mestizo	480	26,816	91.8
	White	2	222	0.8
Monthly labor income	Up to USD 1,000	30	1,358	4.7
	USD 1,001–2,000	395	22,937	78.5
	USD 2,001–3,000	70	3,799	13.0
	USD 3,001–4,000	11	483	1.7
	USD 4,001–5,000	9	248	0.8
	USD 5,001–6,000	6	234	0.8
	USD 6,001–7,000	3	62	0.2
	Missing income	4	85	0.3

Calculations based on ENEMDU 2022. Interviewed *n* represents the unweighted number of survey respondents. Weighted *N* and weighted percentages were calculated using the ENEMDU expansion factor supplied by INEC. The analytical group includes 528 interviewed respondents, corresponding to a weighted population estimate of 29,207 persons. Four respondents with missing labor-income information, representing 85 weighted persons (0.3%), are reported in the table but excluded from the multiple correspondence analysis and hierarchical clustering. Detailed occupational categories correspond to the official survey occupational classification and should not be interpreted as administrative military rank records. Percentages may not sum exactly to 100.0 because of rounding.

administrative registry of military personnel. It does not identify branch, military school, promotion pathway, specialty, formal rank history, or the legal distinctions between military specialization and higher specialization established in the 2023 regulatory framework. Because ENEMDU is designed as a

household survey, it may also underrepresent personnel living in collective or highly institutionalized settings. These limitations are central to the interpretation of the findings and reinforce the role of the study as a pre-reform baseline rather than an evaluation of the 2023 law.

TABLE 2 Labor-market benchmark: armed forces occupational group and general population aged 22–63.

Indicator	Armed Forces interviewed <i>n</i>	Armed Forces weighted <i>N</i>	Armed Forces %	General population interviewed <i>n</i>	General population weighted <i>N</i>	General population %
All persons aged 22–63	528	29,207	100.0	186,152	8,763,995	100.0
Adequate or full employment	523	29,041	99.4	64,836	2,721,970	31.1
Formal public-sector appointment or permanent contract (valid responses only)	528	29,207	100.0	39,903	1,763,251	51.5

Calculations based on ENEMDU 2022. Adequate or full employment refers to the official survey employment category for adequate employment. Formal public-sector appointment or permanent contract refers to respondents whose work arrangement was reported as either an appointment or a permanent contract. Percentages are calculated among respondents with valid information for each indicator. Weighted *N* estimates the corresponding population count; interviewed *n* reports the number of survey respondents.

3 Results

3.1 Descriptive profile of the armed forces occupational group

Table 1 presents the sociodemographic, educational, occupational, and income profile of the Armed Forces occupational group using both unweighted respondent counts and weighted population estimates. The 2022 survey profile shows a predominantly male and married/common-law population concentrated in middle adult ages. The analytical group includes 528 interviewed respondents, representing 29,207 persons after applying survey weights. Men account for 94.6% of the weighted group, and women account for 5.4%. Ages 31–40 and 41–50 account for 41.0% and 33.4%, respectively. Married personnel account for 80.0%, with a further 10.6% in common-law unions. Mestizo self-identification accounts for 91.8% of the weighted group.

Table 1 also shows that educational differentiation was already visible before the 2023 reform. Secondary or middle education accounts for 49.0% of the weighted group, non-university higher education for 18.5%, university higher education for 27.1%, and postgraduate education for 5.3%. Labor income is concentrated in the USD 1,001–2,000 range, which accounts for 78.5% of the weighted group. The detailed Armed Forces occupational categories also show internal differentiation: 11.6% are classified as commissioned officers, 87.0% as noncommissioned officers, and 1.4% as other Armed Forces ranks. Because these are survey occupational categories rather than administrative ranks, they should be read as broad occupational-position indicators rather than direct rank data. Taken together, Table 1 indicates a group that is socially concentrated by sex, ethnicity, and marital status, but differentiated by education and income.

3.2 Labor-market benchmark with the general population

Table 2 benchmarks the Armed Forces occupational group against the general Ecuadorian population aged 22–63. The table shows that the Armed Forces occupational group is located in a more formal segment of the Ecuadorian labor market than the general population of the same age range. In 2022, 99.4% of the Armed Forces occupational group reported adequate or full employment, compared with 31.1% of the general population aged 22–63.

TABLE 3 MCA eigenvalues and inertia.

Dimension	Eigenvalue	Inertia %	Cumulative %
1	0.3106	12.4	12.4
2	0.2654	10.6	23.0
3	0.2498	10.0	33.0
4	0.2045	8.2	41.2
5	0.1797	7.2	48.4
6	0.1767	7.1	55.5

Calculations based on ENEMDU 2022.

Similarly, all Armed Forces respondents with valid work-arrangement information reported either a formal public-sector appointment or a permanent contract, compared with 51.5% of the general population with valid work-arrangement information. The contrast in Table 2 supports the interpretation of military employment as a protected labor-market niche, although the comparison remains descriptive and does not estimate a causal effect of military employment.

3.3 Multiple correspondence analysis

Multiple correspondence analysis was estimated on 524 respondents with valid information on all active variables, representing 29,122 weighted persons after excluding the four income nonresponse cases. The active variables were sex, age group, marital status, education, ethnic self-identification, and income. Table 3 reports the eigenvalues and inertia for the first six dimensions. The first three dimensions account for 33.0% of total MCA inertia. The key point from Table 3 is that the MCA structure is multidimensional: no single dimension dominates the space. Because MCA distributes information across several dimensions when many categorical variables are included, interpretation emphasizes association patterns across categories rather than isolated variables or a single dominant scale.

Supplementary Appendix Table A2 reports the technical diagnostics used to interpret the first three MCA dimensions. Coordinates show where categories are placed on each dimension, contributions show which categories shape each dimension most

strongly, and squared cosine values show how well each category is represented. Dimension 1 primarily separates younger, nonmarried, and demographically less numerous categories from the married/common-law, mestizo, and older modal categories. Dimension 2 distinguishes single respondents, respondents in the other-ethnicity category, and those in the lowest income bracket from women, respondents in the Afro-Ecuadorian/Black/Mulatto category, and respondents in other marital-status categories. Dimension 3 is dominated by postgraduate education and income above USD 3,000, with additional contributions from the oldest age group and non-university higher education. These axes should be interpreted as descriptive association patterns rather than causal dimensions.

3.4 Hierarchical clustering on MCA coordinates

Hierarchical clustering was performed with Ward linkage and Euclidean distances on the first three MCA dimensions. Table 4 evaluates solutions with two to six clusters and provides the statistical basis for selecting a four-cluster exploratory partition for descriptive purposes. Although the Calinski-Harabasz index increases slightly for five- and six-cluster solutions, those alternatives primarily fragment the large modal group without

improving substantive interpretability. Taken together, the silhouette, Davies-Bouldin, and Calinski-Harabasz statistics suggest that the four-cluster partition provides a reasonable balance between separation, parsimony, and interpretability within the three-dimensional MCA space. Because the clustering analysis is exploratory, the resulting groups are used only as descriptive summaries of internal heterogeneity rather than as evidence of stable institutional subtypes. Supplementary Appendix Figure A1 presents the corresponding Ward dendrogram and the retained four-cluster cut.

Supplementary Appendix Table A3 reports the sensitivity analysis. The four- and five-dimensional solutions showed substantial agreement with the primary three-dimensional partition, whereas agreement declined when six dimensions were retained. The large modal cluster remained relatively stable across specifications, but membership in the smaller clusters became less consistent as additional dimensions were included. These results indicate that the clustering solution should be interpreted as an exploratory aid for summarizing patterns of internal differentiation rather than as evidence of fixed institutional types. Consequently, the principal substantive findings of this study derive from the weighted descriptive analysis and the MCA association structure, while the cluster solution is used only as a complementary descriptive summary.

Figure 1 visualizes the relative position of respondents and cluster centers in the first two MCA dimensions. The figure

TABLE 4 Cluster validation statistics for candidate hierarchical solutions.

Number of clusters	Average silhouette	Calinski-Harabasz	Davies-Bouldin	Cluster sizes, weighted %
2	0.496	228.4	0.907	11.0, 89.0
3	0.519	256.4	0.794	11.0, 6.9, 82.1
4	0.542	315.0	0.708	11.0, 6.9, 8.3, 73.9
5	0.461	319.0	0.789	11.0, 6.9, 8.3, 13.3, 60.5
6	0.473	332.2	0.786	2.0, 9.0, 6.9, 8.3, 13.3, 60.5

Calculations based on ENEMDU 2022. Clustering used Ward linkage on the first three MCA dimensions. Higher silhouette and Calinski-Harabasz values and lower Davies-Bouldin values indicate better separation. Cluster-size percentages may not sum exactly to 100.0 because of rounding.

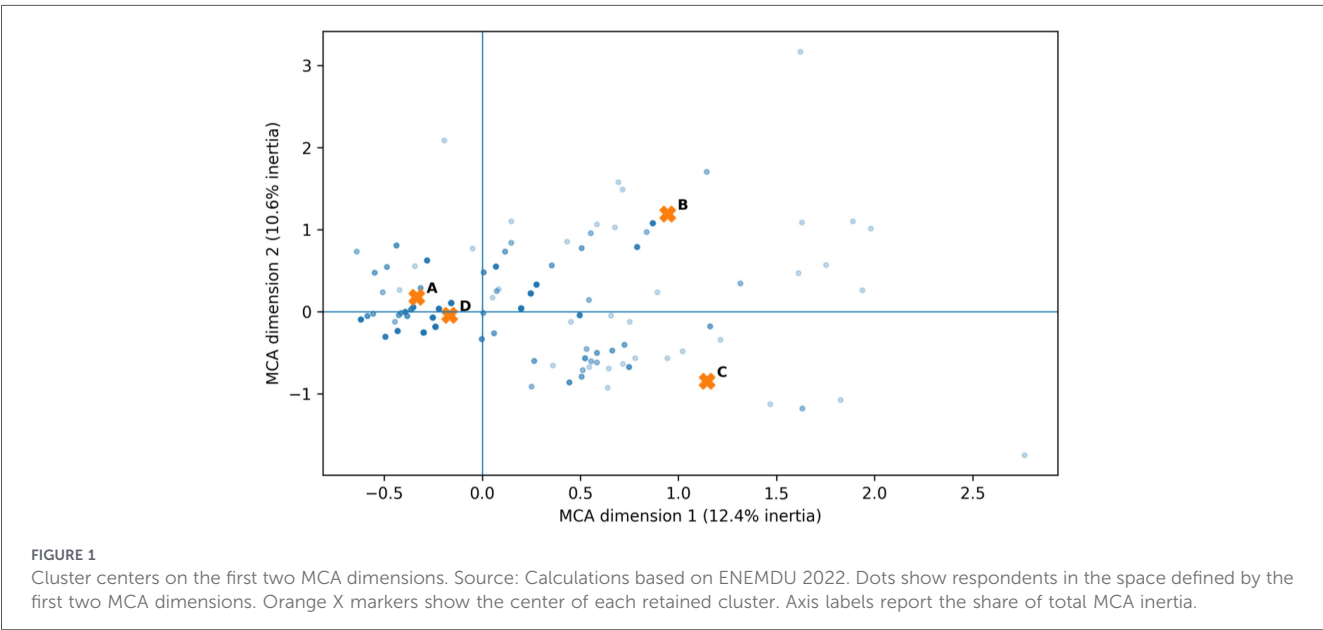


TABLE 5 Descriptive profile of the retained four-cluster exploratory solution.

Cluster	Interviewed <i>n</i>	Weighted <i>N</i> (%)	Profile summary
A. Older profile	73	3,195 (11.0%)	Mean age 44.9; mean years in current job 11.8; mean labor income USD 2,755. Postgraduate education 48.3%; commissioned-officer category 55.1%; income above USD 3,000 29.7%; married/common-law 95.6%.
B. Younger profile	35	2,005 (6.9%)	Mean age 27.1; mean years in current job 4.4; mean labor income USD 1,445. Ages 22–30 89.9%; single 82.1%; university or non-university higher education 82.3%; commissioned-officer category 26.9%.
C. Women/minority profile	50	2,411 (8.3%)	Mean age 36.2; mean years in current job 8.8; mean labor income USD 1,438. Women 51.7%; Afro-Ecuadorian/Black/Mulatto categories 63.2%; USD 1,001–2,000 income 88.8%; noncommissioned category 93.8%.
D. Modal profile	366	21,512 (73.9%)	Mean age 37.4; mean years in current job 9.9; mean labor income USD 1,481. Men 100.0%; married/common-law 99.1%; mestizo 98.2%; noncommissioned category 94.1%; USD 1,001–2,000 income 85.4%.

Calculations based on ENEMDU 2022. Cluster profiles are based on the 524 respondents with complete information for the MCA and hierarchical clustering, excluding four income-nonresponse cases. Weighted *N*, percentages, and means were calculated using ENEMDU weights. Mean years in the current job is an auxiliary tenure measure and is not equivalent to total years of military service. Weighted counts and percentages may not sum exactly to the complete-case total because of rounding.

illustrates that the MCA space contains meaningful internal heterogeneity beyond the modal profile. However, because the clustering procedure is exploratory and the smaller clusters are sensitive to the number of retained MCA dimensions, the figure should be interpreted as a descriptive representation of variation within the occupational group rather than as evidence of distinct institutional subtypes or a rank hierarchy.

Table 5 provides descriptive summaries of the four clusters retained from the exploratory partition. The table is intended to facilitate interpretation of the MCA association structure by summarizing common combinations of characteristics within the sample. Consistent with the MCA results, the clusters differ in age, education, income, and occupational category. Nevertheless, because the clustering solution is exploratory and smaller clusters are less stable across alternative specifications, these profiles should be interpreted as heuristic summaries of observed patterns rather than as fixed population groups.

4 Discussion

The first point to emphasize is interpretive scope. The patterns observed here describe the Armed Forces occupational group before the 2023 reform. They therefore should be read as a baseline of pre-existing educational and occupational differentiation, not as evidence that the new law has already changed educational or labor outcomes.

The results indicate a structured but internally heterogeneous occupational group. Nearly one third of the weighted group already reported university or postgraduate education in 2022, while almost half remained concentrated at secondary or middle education. The detailed occupational categories add an important layer to this picture. Descriptive profiling of the exploratory clusters shows that the commissioned-officer category is more common in the older, higher-credential profile, whereas the noncommissioned category predominates in the large modal cluster. Because occupational category was used to describe rather than construct the clusters,

these patterns should be interpreted as descriptive associations. This pattern is consistent with an education-income hierarchy, but it cannot be interpreted as a full rank or promotion analysis because the survey does not record military rank history, branch, command responsibility, or promotion pathway.

The comparison with the general Ecuadorian population of the same age range shows that the Armed Forces occupational group occupied a highly formal labor-market location. Adequate or full employment reached 99.4% in the Armed Forces group compared with 31.1% in the general population aged 22–63, and formal public-sector appointment or permanent-contract status was universal among Armed Forces respondents with valid work-arrangement data. These results help explain why military employment appears as a protected labor niche within the wider Ecuadorian economy. They remain descriptive, however, and should not be read as a counterfactual estimate of what military service causes.

The MCA results add nuance to the descriptive picture by showing that education, income, age, sex, marital status, and ethnic self-identification do not vary independently. The association structure suggests that higher educational attainment tends to be linked with older age and higher income, whereas the modal categories include married or common-law status, mestizo self-identification, secondary or middle education, and the USD 1,001–2,000 income range. Exploratory cluster profiling adds occupational category as a descriptive characteristic: the commissioned-officer category is more prevalent in the older, higher-credential cluster, while the noncommissioned category predominates in the large modal cluster. The clustering results should nevertheless be understood as illustrative summaries of internal heterogeneity rather than as evidence of fixed institutional subgroups.

Several alternative mechanisms could explain the observed educational and income differences. Seniority is one possibility: the auxiliary measure of years in the current job shows differences across clusters, although it is not equivalent to years of military service. Occupational hierarchy is another possibility: the detailed occupational categories suggest differences between

commissioned and noncommissioned personnel, but they do not provide the fine-grained rank structure needed to distinguish all officer, enlisted, specialist, or branch pathways. Cohort effects may also matter because younger personnel may have entered under different educational expectations than older personnel. Branch differences may also shape education and income, but ENEMDU does not identify Army, Navy, Air Force, or specialized corps. For these reasons, the association between higher education and higher income should be interpreted as a baseline pattern that may reflect institutional selection, hierarchy, seniority, branch, and cohort, rather than as a simple return to education.

These findings are compatible with international discussions on professional military education. Studies of academization and professional military education have shown that military careers increasingly interact with university credentials, civilian academic standards, accreditation, and broader debates on professional expertise (Free, 2026; Hedlund, 2019; Libel and Ateş, 2025; Powell and Townley, 2025). The Ecuadorian reform can be interpreted as part of that wider trend, but the present data only show the starting point from which such a transformation may unfold.

The study has four main limitations. First, the data are cross-sectional and pre-reform, so no causal inference about the 2023 law is possible. Second, ENEMDU is a household survey and may not fully represent personnel in collective, training, or deployment settings. Third, the survey does not identify branch, military school, specialty, promotion history, formal rank trajectory, or the legal categories of military specialization and higher specialization. Fourth, multiple correspondence analysis and hierarchical clustering are exploratory techniques. Although the first three MCA dimensions captured the most interpretable association structure, they account for 33.0% of total inertia. Sensitivity analyses showed that the broad pattern of differentiation remained recognizable across alternative specifications, but cluster membership became less stable as additional dimensions were retained. Moreover, Clusters B and C are based on only 35 and 50 interviewed respondents, respectively. For these reasons, the cluster solution should be interpreted as a heuristic summary of internal heterogeneity rather than as evidence of stable or naturally occurring institutional groups.

This baseline remains valuable for future research. Later ENEMDU rounds, if occupational coding remains stable, may show whether the distribution of higher education within the Armed Forces changes after the reform. Even more informative would be administrative data that identify military schools, specialties, branches, ranks, promotions, years of service, and links with higher education institutions. Those data would allow a direct evaluation of whether the law altered educational trajectories or mainly formalized tendencies already underway.

From a policy perspective, the results suggest that discussions of military professionalization cannot be limited to legal reforms alone. The descriptive and multivariate findings indicate that educational credentials, occupational position, income, and sociodemographic characteristics are already differentiated within the Armed Forces occupational group. A reform that expands higher education opportunities may strengthen professional recognition, but its substantive effects will depend on how educational credentials are distributed, how they interact with occupational hierarchies, and whether they alter career trajectories within the institution.

5 Conclusions

This article examined higher education and occupational differentiation in the Ecuadorian Armed Forces using the 2022 National Survey of Employment, Unemployment, and Underemployment. The argument is deliberately limited: because the survey predates the 2023 Organic Law on Personnel and Discipline, the study does not measure the impact of that reform. It instead offers a pre-reform baseline of the Armed Forces occupational group.

The descriptive and multivariate results show a population that is predominantly male, married or in a common-law union, and concentrated in middle-income brackets, but also marked by clear internal differentiation. Education, age, income, sex, marital status, and ethnic self-identification are associated in ways that suggest a structured occupational field rather than a homogeneous institutional body. Multiple correspondence analysis revealed systematic associations among these characteristics, while exploratory cluster profiling showed additional descriptive differences by occupational category. Exploratory clustering further illustrated this heterogeneity, although the smaller clusters were less stable across alternative specifications and should therefore be interpreted cautiously.

The article contributes in two ways. Empirically, it documents the social, educational, labor-market, and occupational profile of the Armed Forces occupational group immediately before a major legal reform. Analytically, it demonstrates the value of distinguishing between baseline structure and reform effects when studying military professionalization. Establishing this pre-reform benchmark is essential for future evaluations of whether subsequent institutional changes are associated with shifts in educational composition, occupational differentiation, or labor-market outcomes.

Future research should combine post-2023 survey evidence with administrative information on branch, rank, specialization, years of service, military school, and institutional educational pathways. Only that type of design will allow a direct assessment of whether the recent legal framework changed the educational composition of the Armed Forces or mainly formalized an existing process of professionalization. Viewed from that perspective, the 2023 reform is best understood here as a horizon for evaluation rather than as an accomplished effect. The value of the present article lies in establishing the point of departure.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: The data used in this study are publicly available from the National Institute of Statistics and Censuses (INEC) at <https://www.ecuadorencifras.gob.ec/enemdu-2022/>. The analysis uses the 2022 ENEMDU individual respondent file and filters the official occupational category for Armed Forces occupations.

Ethics statement

This study used only publicly available, anonymized secondary data from the 2022 National Survey of Employment,

Unemployment, and Underemployment (ENEMDU), produced by the National Institute of Statistics and Censuses of Ecuador. The dataset is freely available for research and statistical purposes and does not contain information that permits direct identification of individual respondents. Because the study did not involve direct contact with human participants, collection of new personal data, intervention, or access to identifiable private information, review by an institutional ethics committee or institutional review board was not required under applicable Ecuadorian regulations.

Author contributions

HC: Writing – original draft, Writing – review & editing, Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software. ES: Conceptualization, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing, Formal analysis, Investigation. EF-G: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Validation, Writing – original draft, Writing – review & editing. MR: Writing – review & editing. IS: Writing – review & editing.

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References

- Caliński, T., and Harabasz, J. (1974). A dendrite method for cluster analysis. *Commun. Statistics-theory Methods* 3 (1), 1–27. doi: 10.1080/03610927408827101
- Davies, D. L., and Bouldin, D. W. (1979). A cluster separation measure. *IEEE Trans. Pattern Anal. Mach. Intell.* 2, 224–227. doi: 10.1109/TPAMI.1979.4766909
- Fithian, W., and Josse, J. (2017). Multiple correspondence analysis and the multilogit bilinear model. *J. Multivar. Anal.* 157, 87–102. doi: 10.1016/j.jmva.2017.02.009
- Free, J. (2026). Military education and the higher education sector. *The RUSI J.* 171 (1), 40–42. doi: 10.1080/03071847.2026.2607295
- Hedlund, E. (2019). A generic pedagogic model for academically based professional officer education. *Armed Forces Soc.* 45 (2), 333–348. doi: 10.1177/0095327X17749488
- Hubert, L., and Arabie, P. (1985). Comparing partitions. *J. Classif.* 2 (1), 193–218. doi: 10.1007/BF01908075
- Instituto Nacional de Estadística y Censos (2022). *Encuesta Nacional de Empleo, Desempleo y Subempleo (ENEMDU) Anual 2022*. Quito: Instituto Nacional de Estadística y Censos (INEC). Available online at: <https://www.ecuadorencifras.gob.ec/enemdu-anual-2022/> (Accessed February 20, 2026).
- International Labour Organization (2012). *International Standard Classification of Occupations 2008 (ISCO-08): Structure, Group Definitions and Correspondence Tables*. Geneva: International Labour Office. <https://www.ilo.org/publications/international-standard-classification-occupations-2008-isco-08-structure> (Accessed February 20, 2026).
- Jiménez Villarreal, R. X., and Franchi, T. (2020). Fuerzas armadas y seguridad pública: estudio comparado de la legislación en Ecuador y Brasil. *Revista de Relaciones Internacionales, Estrategia y Seguridad* 15 (2), 57–72. doi: 10.18359/ries.4620
- Lacquement, R. A. (2022). “Training and education,” in *Understanding the U.S. Military*, 1st edn. eds. K. Carroll, and W. B. Hickman (Oxfordshire, UK: Routledge), 259–270. doi: 10.4324/9781003154877-21
- Ley Organica de Personal y Disciplina de las Fuerzas Armadas, Suplemento 236 (2023). Available online at: https://www.defensa.gob.ec/wp-content/uploads/downloads/2023/02/LEY-ORGANICA-DE-PERSONAL-Y-DISCIPLINA-DE-LAS-FUERZAS-ARMADAS_ene_2023.pdf (Accessed February 20, 2026).
- Lê, S., Josse, J., and Husson, F. (2008). Factominer: an R package for multivariate analysis. *J. Stat. Softw.* 25 (1), 1–18. doi: 10.18637/jss.v025.i01
- Libel, T., and Ateş, B. (2025). Academic–military relations in U.S. and allied professional military education organizations, 1991–2024: a comparative analysis and proposed typology. *Armed Forces Soc.*, 0095327X251371307. doi: 10.1177/0095327X251371307

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2026.1818645/full#supplementary-material>

- Muñoz Gualán, G. G. (2020). El sistema educativo militar del Ecuador: un modelo innovador. *Revista Cognosis* 5 (3), 45. doi: 10.33936/cognosis.v5i3.2448
- Parra Olivares, J. E. (1996). Modelo de análisis de correspondencias múltiples. *Rev. Cienc. Soc.* 2 (2), 183–196. Available online at: <https://dialnet.unirioja.es/servlet/articulo?codigo=4276768> (Accessed February 20, 2026).
- Pinillos, H. J. (2007). Eglosión de la sociología militar. *Revista Educación y Desarrollo Social* 1 (2), 94–103.
- Polga-Hecimovich, J. (2023). “Civil–military relations and democracy in Latin America in the 2020s,” in *Latin America in Times of Turbulence*, 1st edn., eds. M. Llanos, and L. Marsteintredet (Oxfordshire, UK: Routledge), 188–205. doi: 10.4324/9781003324249-10
- Powell, M., and Townley, D. (2025). The challenges and opportunities for academics in professional military education. *Def. Stud.* 25 (3), 644–661. doi: 10.1080/14702436.2025.2467746
- R Core Team (2025). *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. Available online at: <https://www.r-project.org/> (Accessed February 20, 2026).
- Reglamento General a la Ley Organica de Personal y Disciplina de las Fuerzas Armadas, Segundo Suplemento No. 359 (2023). Available online at: <https://www.defensa.gob.ec/wp-content/uploads/downloads/2023/08/REGLAMENTO-GENERAL-A-LA-LEY-ORGANICA-DE-PERSONAL-Y-DISCIPLINA-DE-LAS-FUERZAS-ARMADAS.pdf> (Accessed February 20, 2026).
- Rousseeuw, P. J. (1987). Silhouettes: a graphical aid to the interpretation and validation of cluster analysis. *J. Comput. Appl. Math.* 20, 53–65. doi: 10.1016/0377-0427(87)90125-7
- Salto, N. (2017). Genealogía y modernización de las fuerzas armadas en el Ecuador. *Ciencia Política* 12 (24), 51–75. doi: 10.15446/cp.v12n24.65327
- Starčević, S., and Blagojević, S. (2021). The autonomy of the military profession as a condition for civil and democratic control of the military and the fulfillment of the main social role of the military. *Vojno Delo* 73 (3), 121–133. doi: 10.5937/vojdelo2103121S
- Ward, J. H. (1963). Hierarchical grouping to optimize an objective function. *J. Am. Stat. Assoc.* 58 (301), 236–244. doi: 10.1080/01621459.1963.10500845
- Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., et al. (2019). Welcome to the tidyverse. *J. Open Source Softw.* 4 (43), 1686. doi: 10.21105/joss.01686