Multimorbidity among the Wayuu people of Colombia: Retrospective cohort study based on administrative data

by

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Abstract

The presence of two or more chronic conditions in the same individual has increased over recent years among different population groups. Studies have indicated that multimorbidity affects many adults and youth and leads to the overuse of healthcare services. In Colombia, the available evidence shows that 19.5% of all patients suffered from several chronic conditions in 2012-2016. The Wayuu people are one of the approximately 115 Indigenous ethnic groups in Colombia, with an estimated population of 380,400 (20% of the Indigenous people in the country). Anas Wayuu (AW) is an Indigenous-led non-profit health insurance company that provides health coverage to Wayuu people and collects data to reimburse health care services.

A retrospective cohort study was performed, including a cross-sectional multimorbidity descriptive analysis. Administrative health records from AW healthcare providers were used as the data source. The purpose of the study was to identify multimorbidity patterns amongst AW enrollees. The Agglomerative Hierarchical Cluster analysis was used. Generalized linear mixed models were fitted for model differences in the healthcare services use rates provided to enrollees.

In total, 159,921 were enrolled in AW in 2014-2017. The descriptive results indicated greater multimorbidity prevalence in female and older populations. Multimorbidity patterns across subpopulations showed morbidity profiles with a higher prevalence of musculoskeletal conditions. Healthcare utilization assessment in 2018-2019 showed higher use among multimorbid patients suffering from circulatory illnesses, Indigenous females and those living in the urban areas.

The evidence about multimorbidity may help identify chronic disease clusters requiring further epidemiological research on causes, prevention, and treatment. The

evidence may also be helpful for healthcare services planning and delivery for AW. The study provides information about multimorbidity among the Wayuu people, contributing to the Colombian population's health status monitoring and analysis strategies using administrative data.

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Chapter 1: Introduction

Wayuu people

The Wayuu people live in La Guajira, Colombia (and in the northeast region of Venezuela), next to the Caribbean. In 2019, La Guajira had a total population of 927,506 and a population density of 29.9 inhabitants per square kilometre (1,2). This territory shows, on average, 50 days of precipitation per year and a temperature of 28°Celsius. The climate is mostly arid and desertic (3). The Colombian Wayuu population is one of the approximately 115 Indigenous ethnic groups in Colombia. It is estimated to be 380,460, representing 20.2% of the Indigenous people in the country and 41% of the population in La Guajira (1,4).

One of the primary sources of income is the production and selling of hand-woven hammocks and handbags. Livestock (primarily goats) is also essential, as are other informal sources of revenue. The Wayuu population mainly lives in small rural villages and hamlets spread across the region. Most communities lack running water and sanitation and no electricity in their houses. Access to clean water is a concern in most Wayuu communities (5). In terms of the health situation of the Wayuu in Colombia, the epidemiological profile is of illness linked to poverty, with some specific aspects related to geography (scarcity of water) and culture (social organization and economic activity). The most frequent pathologies include malnutrition and respiratory and gastrointestinal infections among children under five (6). As well, sexually transmitted diseases, uterine/cervical cancer, hypertension, injuries due to violence, caries and other dental problems are shared among all ages (7).

Anas Wayuu

Anas Wayuu (AW) is an Indigenous-led non-profit health insurance company that provides health coverage mainly in La Guajira, Colombia department. It was created in 2001 by two Indigenous associations comprising 120 Indigenous authorities from Wayuu communities, managed mainly by professionals of Wayuu origin, in a large proportion bilingual (*Wayuunaiki* and Spanish). AW currently provides health care coverage to approximately 260,000 people, of whom 71% are Indigenous Wayuu. For these purposes, AW contracts a healthcare network made up of 27 Indigenous healthcare institutions (IPSI) and 65 non-indigenous healthcare provider institutions (IPS), through which it provides coverage to enrollees needing healthcare in La Guajira and, if necessary, at the national level (5).

Being an Indigenous health organization, AW offers bilingual guides for Wayuu families that do not speak Spanish. It also provides temporary hostel accommodation to clients and family members when they need health services in an urban center distant from their residences. AW also supports community programs linked to traditional Indigenous medicine practices, seeking to articulate and complement the Western health system. Intercultural health and holistic healthcare are central notions of AW's mission. AW has been one of the most successful health insurance institutions in Colombia, ranked in 2012 as the number one performing in the country (5).

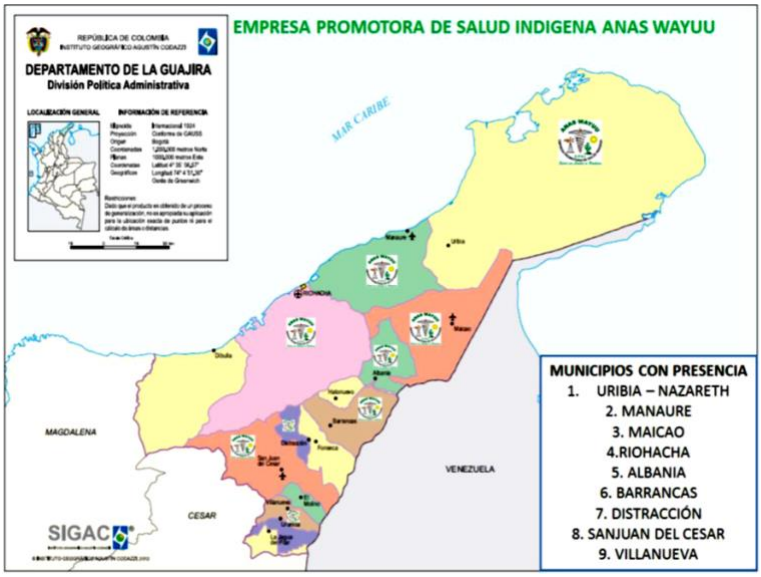


Figure 1. AW Enrollee's municipality of residence, Department of Guajira, Colombia

Public Health Surveillance Data Sources in Colombia

In 2001, the Colombian Ministry of Health established the Registry of Health Services Provision (RIPS- Spanish abbreviation) as an electronic Data Collection strategy for gathering information regarding healthcare utilization in the population enrolled in the Healthcare System. The Administrative Health Records (AHR) structure and features are standardized for all healthcare institutions nationwide, including Indigenous people enrolled in Health companies, through subsidized financing (8,9). These records are the primary data source for the Colombian Health Care System's direction, regulation, and monitoring processes. AHR collect patient identification and healthcare service delivery data to ensure information flow and facilitate financial exchanges among the Ministry of Health, health insurance organizations and healthcare institutions. These records are also used to support decision-making in the healthcare process, aimed at the health system's administrative and operational improvements, and for accountability purposes (10,11).

Although Colombian AHR can be a primary data source for public health research in Colombia, they have limitations in producing evidence to assess and enhance healthcare service use (10). One significant advance was the implementation of the Public Health Surveillance System to monitor the incidence of public health events, mainly infectious diseases (16,18). Despite adopting technological infrastructure for data management, areas for improvement remain. There is still space to increase the experience of performing individual-level administrative data analysis and communicating research evidence (12,13).

Public health surveillance is relevant in contexts where health outcome information is limited. Public health surveillance is a strategy that may assist in closing health inequity gaps among social groups. It consists of the systematic and continuous collection, analysis, and interpretation of administrative data. It seeks to produce information for the planning, execution, and evaluation of public health practice. For surveillance to succeed, it must include health status analysis, public health research findings, health information systems, and planning and provision of the population's healthcare services (14,15).

Chapter 2: Background

Intercultural Health Care in Colombia

Interculturality implies inclusive and respectful relationships between culturally diverse social groups and institutions, sharing territorial, linguistic, and legal spaces. Intercultural relations dictate recognizing others based on their rights and not granting special privileges to one group (16). Specifically, intercultural health occurs at different instances of care concerning different practices, at varying levels, including that of the family, practitioner, health center, hospital, and health system (17). It transcends ethnicity since it includes valuing the human being's biological, cultural, and social diversity, which is vital in the health-disease process (18). Therefore, interculturality is a central element for the consolidation of more equitable and participatory healthcare systems, considering a weakened patient–healthcare relationship due to limited cultural competencies in care providers and differences in belief systems, values, perceptions, expectations, and style of expression and behaviour (19–21).

In one type of intercultural healthcare model, social groups have governance over biomedicine and traditional healthcare. One of the potential benefits of this articulation is improved access and quality of care (22). Considering ethnic groups' rights requires having relevant, reliable, and timely information. Including interculturality in the demographic and social data sources, such as population censuses, household surveys and health records, may increase citizen participation based on cultural pluralism. The Indigenous peoples are already carrying out this task, searching for recognition, restitution, and participation (9).

The Colombian Government has recognized medical pluralism, therapeutic complementarity, and interculturality in the healthcare model (23). In 1993, the Colombian

healthcare system transitioned from wholly public to mixed healthcare, including private (Contributor, Special, Teachers/Professors, Public Force) and public (Subsidized) healthcare Regimes. This reform sanctioned private institutions as managers of both regimes' funding. The public regime includes Indigenous peoples, low-income, unemployed, non-pensioned population, and other ethnic groups. The private regime comprises employed people and those capable of paying for health care (24,25). In 2001, the Government regulated the participation of Indigenous peoples in the healthcare system. Indigenous traditional authorities were allowed to establish non-profit health insurance companies to manage the public regime funding and provide health coverage to the Indigenous population. This healthcare model reform sought to protect the right to health among Indigenous peoples while recognizing the traditional authorities' unique legal and organizational nature (23).

Multimorbidity

The construct of Multimorbidity used in medical research is often variable (26–29). There is a growing consensus that internationally accepted definitions are required (29). Terms such as comorbidity and frailty are used interchangeably. Multimorbidity differs from comorbidity because there is no index condition. However, both constructs are not mutually exclusive since these present alternative ways of understanding the coexistence of numerous conditions in a patient (26,29). Frailty refers to populations with high vulnerability to adverse outcomes requiring long-term care; patients with multimorbidity may or may not be frail (26,30). This variability has caused difficulties in interpreting information about multimorbidity. To address these issues, The Academy of Medical Sciences has recommended the adoption of a standardized multimorbidity definition that is

consistent with the one proposed by the World Health Organization (WHO): the coexistence of two or more chronic conditions, which can be a non-communicable disease, a mental health condition, or a long-term infectious disease (29,31).

Information on multimorbidity is essential for planning healthcare provisions for people with several chronic conditions (29). Studies have suggested that multimorbidity affects the quality of life and increases healthcare services use (32–35). In multimorbidity, diseases may interact with each other, either in pathophysiology or clinical care. Multimorbid patients frequently require extensive and continuing treatment. These interactions have an impact on safety in health care. Patient safety events may involve adverse drug events, intervention complications, delayed diagnosis, medication adherence and inappropriate prescribing. The interactions and numerous treatments in multimorbidity and adverse socio-economic conditions can cause significant patient safety encounters at any stage of life (26,29,31). Therefore, understanding how different chronic diseases cluster together can help develop treatment guidelines for patients with multimorbidity.

Scientific evidence about multimorbidity is limited in Colombia. Following the proposed construct definition, two cross-sectional studies were performed during the last decade. A survey-based research project conducted in 2012-2013 suggested a multimorbidity prevalence of 17.5% (36). A population-based study by The World Bank Group using AHR indicated that, on average, 19.5% of people suffered two or more chronic conditions from 2012-2016 (37). The available evidence generally describes multimorbidity in Colombia but needs more description from an intercultural perspective.

Hierarchical cluster analysis (HCA) is one of the most common methods for investigating multimorbidity patterns (38,39). HCA is a data mining and statistical method

for finding the association of diagnoses and determining patterns of multimorbidity based on disease dissimilarities. The diagnoses in the HCA cluster are similar yet different from those in other clusters (40). HCA is best suited to classification issues involving objects linked by a systematic structure. Chronic diseases can arise together for a variety of causes. Certain diseases have genetic, environmental, or behavioural risk factors in common. Multiple chronic consequences can result from a single chronic condition (41). Consequently, the present study used an agglomerative hierarchical technique to find multimorbidity clusters.

Agglomerative and divisive algorithms are two types of strategies for hierarchical clustering. The agglomerative method, a "bottom-up" approach, creates a succession of data partitions, starting with the simplest cluster of a single object and progressing via groups of objects until the ultimate grouping includes all the original objects. The divisive algorithm, a "top-down" approach, starts with a single large cluster and gradually breaks it into smaller clusters. Divisive algorithms utilize metrics of association that incorporate both negative and positive matches when working with binary data (40).

Study purpose

The study sought to identify multimorbidity patterns and compare healthcare utilization in multimorbid AW Indigenous enrollees. The study answered the research questions (1) What is the prevalence of multimorbidity amongst AW Indigenous enrollees? (2) What are the multimorbidity typologies of AW Indigenous enrollees suffering two or more chronic conditions? and (3) How do the multimorbidity patterns relate to healthcare use? In this scenario, three specific objectives were proposed: to (1) describe the prevalence of multimorbidity among Indigenous enrollees who used healthcare, (2) identify

multimorbidity patterns amongst Indigenous enrollees suffering two or more chronic conditions, and (3) examine how multimorbidity patterns are associated with healthcare services use.

Chapter 3: Methods

Study Design and Population

A retrospective cohort study was performed including a multimorbidity prevalence period analysis. The cross-sectional period prevalence and multimorbidity patterns were described for 2014-2017. Health service utilization amongst patients' multimorbidity patterns was longitudinally assessed over 2018-2019. This design can provide information about chronic conditions more likely to co-occur and the prevalence of multimorbidity among a specific population.

The study population was AW enrollees who were 18 years old or over, lived in the department of La Guajira, Colombia, and used health services any time between January 1st, 2014, and December 31st, 2017. During 2014-2019, AW had 267,776 enrollees, of which 71.4% were Indigenous, and 51.8% were female. Most enrollees (89.9%) lived in the municipalities of *Maicao*, *Uribia* and *Manaure*.

Data sources

Administrative Health Records (AHR) from AW were used to identify multimorbidity clusters. AHR structure and features have been unified and standardized for all health service providers nationwide (10). Hospitals and healthcare institutions periodically provide data to the AW Information System department, consolidating and validating AHR (5). AHR comprise several data sets, including consultations, emergencies, and hospitalization. Data include features regarding patients' demographic and enrollment characteristics, visit dates, primary diagnosis type, and patient's disease diagnosis.

Additionally, data include clinical procedures records, which describe the disease diagnosis associated with therapies and clinical aids provided to patients during disease management. AHR data give information on cases of disease diagnosis recorded with the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10). According to an official report, AHR data have shown percentages of accurately recording patients' demographic characteristics and diagnostic coding of 95 and 83.4 percent, respectively (42) compared to clinic history.

The figure # 2 below describes the data collection process for gathering AHR in AW. After patients' health care requests, they can access medical care through either emergency or consultation services. Referral amongst services, including hospitalization, might be observed during a patient's visit. Then, patients can obtain disease treatment through either ambulatory or hospitalization services. Records are consolidated and coded using the ICD10 standard. Finally, all healthcare institutions providing medical care to enrollees transfer data to AW's Information System Department.

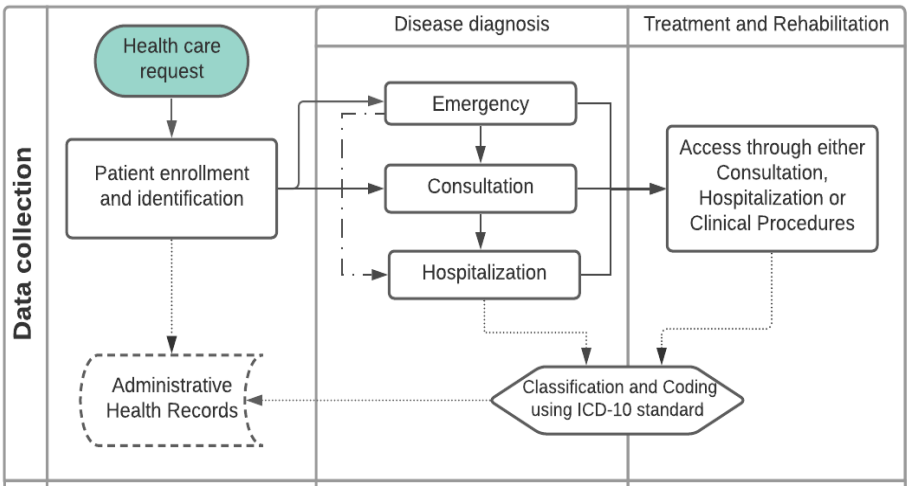


Figure 2. Synthesis of Data collection processes operated by healthcare providers in Colombia

Data privacy

Data de-identification involved removing personally identifying information to protect AW enrollees' privacy. Data handlers from AW System Information Department de-identified the data sets. The process involved taking the original data, removing enrollees' personally identifying information, and assigning a random number as an identification number. Since patients' data needed to be linked to study objectives, data anonymization was not used as a privacy strategy. Using anonymized data (aggregate level data) for healthcare services research would be a challenge when the study requires data about individual patients' claims and healthcare trajectories. Original data anonymization involved removing enrollees' personal information and assigning a random number as identification number. Converting personal identifiable information into aggregate data would not have allowed the research team to merge data sets, and extract data as required.

Data structuring

Data sets were linked using the patient's de-identified identification number. Enrollment records were linked to AHR to consolidate patients' health services usage history and clinical and demographic information. Three potential referrals during the health care services delivery and amongst services were considered to avoid overestimating chronic condition cases. The possible referral scenarios are from Emergency services to Hospitalization, Physician visits to Hospitalization, and Emergency to Consultation. Enrollees' de-identified identification, ICD-10 four-digit disease diagnosis code and visit date were used to identify patients suffering from chronic conditions.

Inclusion criteria

Objective 1: [1] being enrolled in AW any time between 2014 and 2017, [2] being enrolled during a year or more, [3] self-identification as an Indigenous person.

Objective 2 & 3: [1] being enrolled in AW and having used healthcare any time between 2014 and 2017, [2] being enrolled in AW for at least one calendar year, [3] self-identification as an Indigenous person, [4] AW enrollee suffering chronic conditions with age- and sex-specific prevalence higher than 1%.

Exclusion criteria

Those not having AHR available for any reason or the quality of the information not being acceptable for data analysis.

Chronic condition case definition

Chronic condition cases were AW enrollees suffering from chronic illnesses. Cases included patients with at least one physician visit, hospitalization, or clinical procedure for the chronic disease diagnosis. Total claims with the ICD-10 four-digits code data between 2014-2017 were included. For all AHR, the main diagnosis position was used to determine chronic conditions cases. In objective # 2, only those chronic conditions with sex- and age-specific prevalence greater than 1% were selected to explore multimorbidity patterns.

A listing of 53 chronic conditions based on ICD-10 subcategories was considered for data extraction. The selected chronic conditions have been included in previous research exploring multimorbidity among patients (Appendix-Table 1) (32,43–45).

According to data availability, demographic characteristics included were enrollees' residence zone, sex, and age. The enrollees' household size and healthcare affiliation

regime information were included. Variables regarding date of access to healthcare, primary diagnosis, procedure purpose and patient service referral were used to identify chronic condition cases.

Table 1. Study variables, Administrative Healthcare Records

Variable description	Level of measurement	Values	Data set*
Age	Ratio		Enrollment
Sex	Nominal	1: Male; 0: Female	Enrollment
Zone of residence	Nominal	1: Urban; 0: Rural	Enrollment
Household size	Ratio		Enrollment
Healthcare system affiliation Regime (User type)	Nominal	1: Contributor 0: Subsidized	Enrollment
Date of access	Nominal	YYYY-MM-DD	PV, HO, EM, CP
Primary Diagnosis	Nominal	ICD-10 four digits code	PV, HO, EM, CP
Primary Diagnosis type	Nominal	1: diagnostic impression 2: new and confirmed 3: repeated and confirmed	PV
Diagnosis at discharge	Nominal	ICD-10 subcategory (four digits code)	HO, EM
Patient service referral	Nominal	1: emergency discharge 2: referred to more complex treatment level 3: hospitalization	PV, HO, EM, CP
Procedure purpose	Nominal	1: Diagnostic 2: Therapy 3: Specific protection 4: Early detection of general illness 5: Early detection of professional illness	CP

*PV: Physician visits; HO: Hospitalization; EM: Emergency visits; CP: Clinical procedures claims

Data quality

Data quality was assessed using four elements of the Reliability dimension: Uniqueness, Consistency, Accuracy and Completeness (46,47). Uniqueness was evaluated

using the duplicity indicator, expressed as the relationship between the number of records with at least one duplicate and the total records in the dataset. Consistency was assessed by verifying the logical connection between the patient's age and sex versus disease diagnosis. Accuracy was determined by comparing variables to the reference values according to the AHR dictionary guidelines (11). Completeness was measured by performing exploratory data analysis to describe data distribution and identify missing mechanisms. Incomplete follow-up because of either enrollees' death, insurance coverage ending, or insurance company change was considered during the data missingness assessment. Descriptive statistics were used to examine numeric variables' distribution and central tendency, and frequencies and percentages were computed for categorical variables.

Statistical analysis

Objective 1. To describe the prevalence of multimorbidity among enrollees, we summarized the cross-sectional 2014-2017 period prevalence of chronic conditions by sex, age groupings (18-24, 25-44, 45-64, 65+ years), zone of residence and type of healthcare affiliation regime. We computed frequencies and percentages for categorical variables and then described the patients' multimorbidity (yes/no). The Exact Fisher, Chi-square, and Mann-Whitney U (for numeric variable) tests were used to assess significant differences. Univariable Logistic Regression models were used to identify the unadjusted associations of each covariate with the binary outcome (48). The multivariable Logistic Regression model was performed using the purposeful variable selection method.

Objective 2. To identify multimorbidity patterns amongst enrollees suffering two or more chronic conditions. Agglomerative Hierarchical Cluster analysis using the Ward method was performed. A binary variable was computed (diagnosed yes/no) for each

chronic condition to fit the clustering analysis. The Ward method aims to find compact clusters and minimize the within clusters variance. The Jaccard coefficient was used to assess the similarity of clusters, which examines those diagnoses shared by any two patients and ignores diagnoses shared by none (40). The Gap statistic method was used to suggest an optimal number of clusters, by comparing the total intra-cluster variance for various clusters to their expected values under a null reference data distribution. Thus, the value that maximizes the statistic estimates the optimal clusters (49). Silhouette plots and dendrograms were used as visualizations for verifying the optimal number of clusters (40). Evidence about multimorbidity has shown differences in the prevalence of specific clusters of chronic conditions due to the interaction of potential causal factors (i.e., smoking, alcohol consumption) with age and sex (50–52). Therefore, multimorbidity patterns were explored in the total sample and separately for total males and females. Additional HCAs by sex and age-specific (18-44, 45-64, and 65 years and over) were performed to explore consistency in multimorbid patterns according to sex and age.

Objective 3. To compare multimorbidity patterns regarding health services use: the number of healthcare services delivered to multimorbid patients was computed for 2018-2019. The study outcome considers the total count of clinical procedures used, hospitalizations, and physician and emergency visits. The ICD-10 codes in the primary diagnosis position were used to ascertain visits. Biannual counts of healthcare services were computed to account for enrollees who died or transferred to another Health insurance company (dropouts) during the follow-up period. Outcome data equal to zero was assigned to semesters where a clustered patient did not show healthcare use but was enrolled in AW.

Information about the status change date (date of leaving AW/dead) was used to identify zero values and dropouts in the 2018-2019 following-up period.

Some statistical model distributions for the inference of count data, such as the Poisson, Negative Binomial (NB), and Zero-Inflated regression models, can be used to address over-dispersion and excess zeroes. The NB model includes a dispersion parameter that relaxes the assumption of equal mean and variance in the distribution, while the Zero-Inflated regression models help estimate the distribution of count outcomes with excess zeroes (53). Overdispersion problems were tested based on whether the residual variance of a given regression model was larger than what was expected. A generalized linear mixed model (GLMM) was then fitted to model differences in the total health care services provided to AW enrollees, stratified by sex. The Time variable (6-month intervals for the 2018-2019 period) and the level-2 predictors, such as user type, zone of residence and household size, were considered in the analyses (if the data missingness assumption is met).

Firstly, the unconditional model was fitted with no predictors at either level, followed by the unconditional growth model with Time as the only level 1 predictor and no substantive predictors at level 2. Then, conditional growth models were fitted by including each level-2 predictor separately. The Likelihood ratio test was used to compare the models. Models were fitted using the Adaptive Gaussian quadrature (AGQ) algorithm, as it requires less computational complexity and memory usage for approximating the multilevel GLMM likelihood (54).

All statistical analyses were performed using R software version 3.0.1. Data processing was made using PostgreSQL free software version 14.8. A significance level of 0.05 was used to evaluate the statistical significance.

Ethical considerations

The study follows the guidelines of the Declaration of Helsinki of the World Medical Association (55), the Belmont Report (56), and the Ownership Control Access and Possession principles (OCAP) as it relates to Indigenous data. It also follows indications from National Regulation # 8430 of the Ministry of Health of Colombia that establishes scientific standards for health research in Colombia (57). The study may help maximize the value of the Colombian EHR by using it to explore multimorbidity typologies among patients. Anas Wayuu approved the study idea, being a topic, they want to explore and use the evidence for their programming. Despite these benefits, there are potential risks regarding the re-identification of individuals and the disclosure of sensitive information. According to the Tri-Council Policy Statement, this research can be considered to cause minimum trouble to participants (58). This research maintained the privacy and confidentially of data by adopting several strategies: data was not linked to other information except healthcare records; access to the database was provided only to those involved in the analysis process; nobody outside the study was allowed to access to data; the database is password protected and stored securely until no longer needed. The Health Research Ethics Board of the University of Manitoba approved the description of the data management strategy.

The study was carried out under the approval of the Anas Wayuu (AW) management. The research question and objective were discussed with and approved by the president of AW. A data-sharing agreement was signed with AW following the OCAP principles developed by Canadian First Nations. Given that researchers not belonging to AW are not allowed to access non-anonymized data, AW staff de-identified records of all

enrollees. Accessing anonymized AHR was granted remotely per the data-sharing agreement signed through remote access to the AW data repository. The student accessed data using a username and password assigned by AW staff.

Obtaining permission from the study participants was not feasible due to the sample size and geographical distribution. Furthermore, since some individuals might have left AW or died after 31 December 2019, it would not have been possible to obtain consent. Nevertheless, as a health insurance organization, AW is authorized by Colombian legislation to use AHR for enrollees' health status monitoring and research purposes without obtaining prior consent.

Chapter 4: Results

Administrative Health Records Data Quality

Data missingness, duplicity and consistency were assessed in each data set included in the Administrative Health Records (AHR). Most attributes in data sets showed the expected feature values according to the AHR set's model and Codebook implemented by the Health Information System Department of The Colombian Ministry of Health in 2000 (10). Percentages (<5%) of inconsistent values were observed in the dataset's characteristics regarding the primary diagnosis four digits code. External cause attribute showed data missingness (<1%) in emergency visits and hospitalization data sets in 2014-2019. Disease diagnosis data was inconsistent in less than one percent of Hospitalization and Clinical procedures data sets. Hospitalizations and Clinical procedures had acceptable percentages of duplicity, with nearly 7% in 2019 (see Appendix 2 to 8 for more information on AHR Exploratory Data Analysis).

Indigenous Enrollees' Characteristics and Multimorbidity

By 2020, 305,126 people had enrolled in Anas Wayuu (AW) to access healthcare services regarding health promotion, disease diagnosis, treatment, and rehabilitation. Amongst them, 159,921 (52,4%) were enrolled in AW for at least one year during 2014-2017, of which 78.4% (n=125,415) self-identified as Indigenous, Wayuu people (Appendix 9). Nearly 52% of indigenous enrollees were women. By the end of 2017, 39% were younger than 18, while 19.1% were 45 years or older. Most enrollees lived in rural areas (85.8%) in municipalities such as Uribia and Manaure, located north of La Guajira. Around 87% belonged to the Healthcare system Subsidized enrollment regime (covariate: User type), and 34.8% did not use healthcare services between 2014 and 2017. Healthcare

services utilization considered physician visits, hospitalizations, emergency visits, and clinical procedures; drug prescriptions were not included during percentages computation (see additional description in Appendix - Table 10). The percentage of no healthcare services utilization in age groups ranges from 21.5 in the youngest to 43 percent in those older than 64 (Table 2).

Multimorbidity estimates showed variability regarding the patient's sex, age, and residence zone, but information about healthcare use may also contribute to the study's phenomena distribution. The period prevalence of multimorbidity was 8.2% (95%CI: 8.0, 8.3) amongst indigenous enrollees in 2014-2017. Females showed higher prevalence than the male population (10.9% vs 5.3% respectively. $x^2_{(df=1)} = 1333$; p<0.001), while those living in rural areas had a lower age- and sex-specific prevalence of multimorbidity compared to those from urban areas. These patterns may suggest population groups at risk, however, AHR data also provides information about patients' behaviors regarding healthcare use, where the female population and those living in the urban zone had higher percentages of services utilization. Concerning age groupings, the prevalence increased ranging from 3.1% (95%CI: 2.9, 3.2) in the youngest to 19.5% (95%CI: 18.7, 20.3) in older people (Table 2). Differences in the multimorbidity prevalence indicator are observed by comparing female and male populations by age groups in each area of residence (Figures 1a & 1b).

Table 2. Demography characteristics and multimorbidity among Indigenous enrollees, 2014-2017, data: AHR, n=125415

Variable		n (% column)	Number of chronic conditions		Multimorbidity Prevalence (95% CI)	No healthcare utilization n (% within strata)
			Mean (SD)	Median (Q1,Q3)		
Total population		125415 (100)	1.6 (1.09)	1 (12)	8.2 (8.0; 8.3)	43660 (34.8)
Sex*	Female	64947 (51.8)	1.7 (1.17)	1 (12)	10.9 (10.7; 11.2)	19785 (30.5)
	Male	60468 (48.2)	1.4 (0.92)	1 (12)	5.3 (5.1; 5.4)	23875 (39.5)
Age (years old)	<18	48939 (39)	1.2 (0.49)	1 (11)	3.1 (2.9; 3.2)	10526 (21.5)
	18-24	20690 (16.5)	1.4 (0.77)	1 (12)	5.5 (5.2; 5.9)	9551 (46.2)
	25-44	31873 (25.4)	1.7 (1.01)	1 (12)	9.9 (9.6; 10.3)	13912 (43.6)
	45-65	14558 (11.6)	2.1 (1.46)	2 (13)	18.1 (17.5; 18.8)	5649 (38.8)
	65+	9355 (7.5)	2.2 (1.5)	2 (13)	19.5 (18.7; 20.3)	4022 (43.0)
User type	Contributor	1239 (0.9)	1.7 (1.11)	1 (12)	15.6 (13.6; 17.7)	200 (16.1)
	Subsidized	108938 (86.9)	1.6 (1.09)	1 (12)	9.3 (9.1; 9.4)	28272 (26)
	Missing	15238 (12.2)	1 (0)	1 (11)	-	15188 (99.7)
Municipality of residence	Maicao	42556 (33.9)	1.7 (1.24)	1 (12)	9.4 (9.1; 9.7)	16905 (39.7)
	Uribia	46801 (37.3)	1.4 (0.86)	1 (12)	6.4 (6.2; 6.6)	11659 (24.9)
	Riohacha	9456 (7.5)	1.7 (1.21)	1 (12)	7.8 (7.3; 8.4)	4011 (42.4)
	Manaure	17428 (13.9)	1.7 (1.08)	1 (12)	11.6 (11.1;12.1)	7346 (42.2)
	Albania	7261 (5.8)	1.5 (0.99)	1 (12)	4.2 (3.8; 4.7)	3442 (47.4)
	Barrancas	1015 (0.8)	1.6 (0.82)	1 (12)	10.1 (8.4; 12.2)	132 (13.0)
	San Juan	271 (0.2)	1.7 (1)	1 (12)	13.7 (9.8; 18.3)	92 (33.9)
	Villanueva	69 (0.1)	1.9 (1.35)	1 (12)	13 (6.1; 23.3)	10 (14.5)
	Distracción	558 (0.4)	1.7 (1.08)	1 (12)	11.3 (8.8; 14.2)	63 (11.3)
Area of residence**	Urban	17834 (14.2)	1.9 (1.4)	1 (12)	11.9 (11.4; 12.3)	7725 (43.3)
	Rural	107581 (85.8)	1.6 (1.01)	1 (12)	7.6 (7.4; 7.7)	35935 (33.4)

Q: Quartile; CI: Confidence Interval. A two-sample test for equality of proportions with continuity correction: * $x^2_{(df=1)} = 1333$; ** $x^2_{(df=1)} = 372$

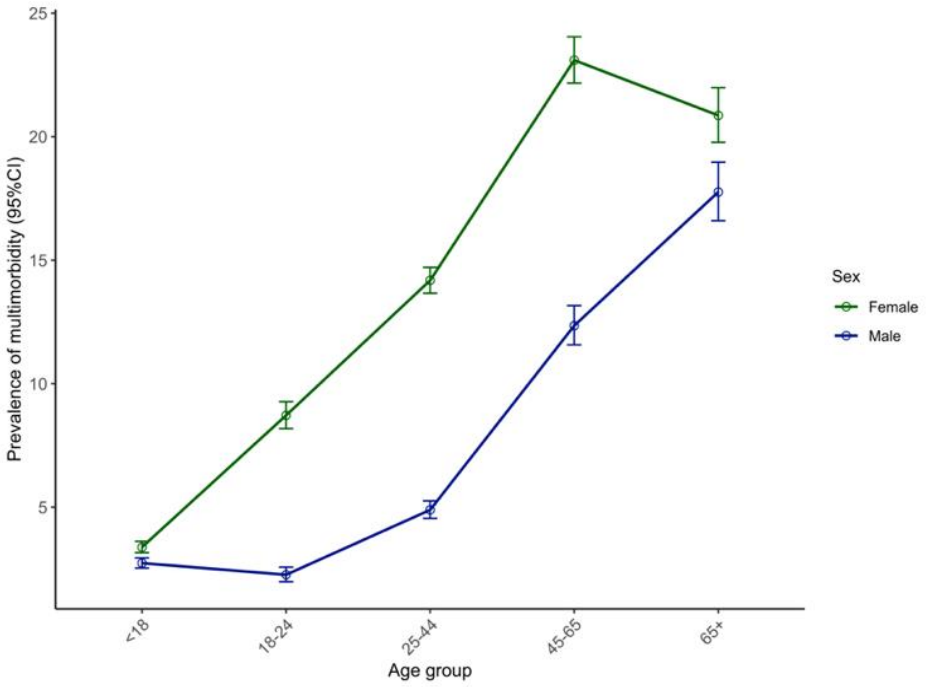


Figure 3. Prevalence of Multimorbidity in Indigenous enrollees by age and sex, 2014-2017, data: AHR, n=125415

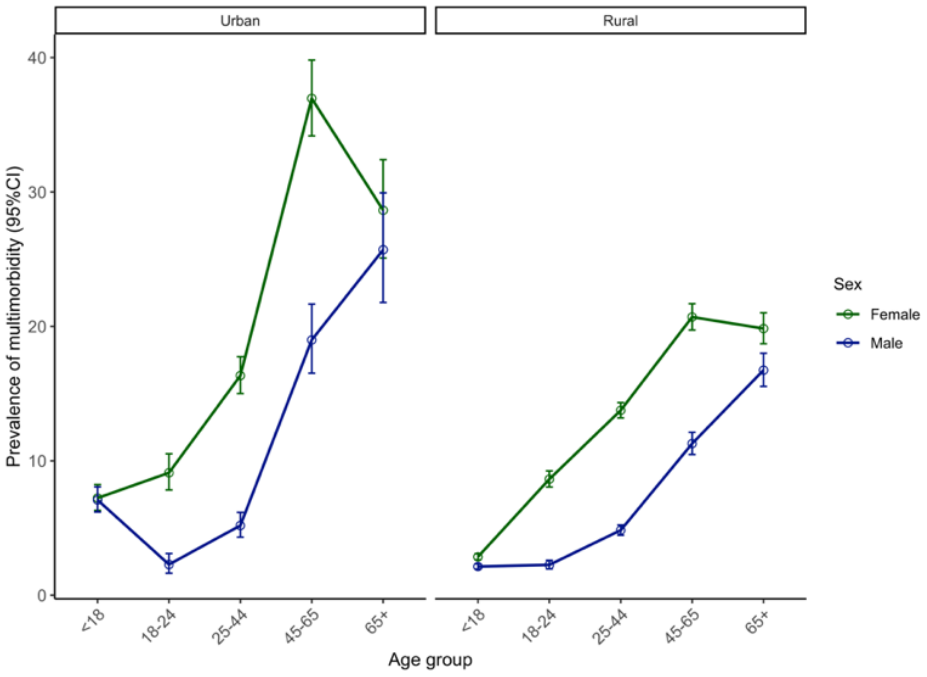


Figure 4. Prevalence of Multimorbidity in Indigenous enrollees by age and sex, according to the residential zone, 2014-2017, data: AHR, n=125415

CI: Confidence Interval

The estimated Odds ratios for “suffering from two or more chronic conditions” (Multimorbidity: Yes/No) are presented for those Indigenous enrollees older than 17 years (n=76476; 61%) who met the enrollment time criteria (Appendix-Figure 1. Study population). The odds of suffering from multimorbidity in females were 2.4 times (95%CI: 2.3, 2.5) that of Indigenous males. The estimated adjusted OR also increased over age groups compared to young adults aged 18 to 44. Indigenous enrollees living in an urban area (Urban/Rural: OR=1.29, 95%CI: 1.22, 1.4) and La Guajira’s middle region (Middle/Upper: OR=1.37, 95%CI: 1.30, 1.45) showed higher odds of suffering from two or more illnesses, in contrast to the lower region. Characteristics such as being female, living in a rural area, and being enrolled in AW in 2010-2013 showed higher odds of suffering from multimorbidity (Table 3). Status by 2017 (Alive, Dead) was considered a secondary outcome; therefore, its inclusion was beyond the study's general objective. The final model's good-ness-of-fit indicators suggested no collinearity among Model covariates (Variance inflation factor indicators < 5), and the final model standardized residuals distribution oscillated between ±3 standard deviations (Appendix Table 20 & 21).

The distribution of chronic conditions shows similar morbidity profiles in females and males characterized by higher prevalence in musculoskeletal and circulatory chronic illnesses. The top 10 most prevalent conditions among the total population (18+ years old) included Chronic low back pain (6.9%), Chronic pain (6.4%), Genitourinary diseases (4.1%), Dizziness (3.8%), Hypertension (2.8%), Gastritis (2.4%), Chronic periodontitis and gingivitis (2.4%), Anemia (2.1%), and Migraine/chronic headache (2.1%). Compared to Indigenous females (n=40883, 53.4%), Indigenous males (n=35593) showed a higher prevalence of Severe constipation and Vision reduction but lower percentages in

Genitourinary diseases and Dizziness conditions (see total, sex- and age-specific prevalence of conditions in Appendix Tables 14 to 18).

For the 2014-2017 period, cross-sectional findings describe differences in the multimorbidity prevalence among AW enrollees according to location and demographic characteristics. Based on the listing of chronic conditions used for data analysis, enrollees show a higher prevalence of muscular and circulatory chronic illnesses, with profiles differing by sex but similar regarding most frequent conditions. Study indicators suggested that Females and older patient groups showed higher use of healthcare and risk of multimorbidity than males and the younger groups, respectively (Table 3). Despite healthcare use among enrollees living in urban areas was lower, there were higher odds of multimorbidity among those older than 18 years from the same area (Table 2, additional information, Appendix Table 19). Results describing multimorbidity period prevalence offer information to identify those at higher risk of multimorbidity with specific healthcare use patterns to be considered during estimates interpretation.

Table 3. Multimorbidity (Yes/No) in indigenous enrollees older than 17 years old, reference=No, 2014-2017, n=76476

Row percentages are computed unless otherwise specified

Variable	Total n (%column) *N=76476*	Yes *N=8776 (11.4%)*	No *N=67700 (88.6%)*	Odds Ratio [95%CI]	Adjusted Odds Ratio [95%CI]	p-value*
Sex:						<0.001
Male	35593 (46.5)	2499 (7.0)	33094 (93.0)	Ref.	Ref.	
Female	40883 (53.5)	6277 (15.4)	34606 (84.6)	2.40 [2.29;2.52]	2.4 [2.29;2.52]	
Age:						<0.001
18-24	20690 (27.1)	1146 (5.5)	19544 (94.5)	Ref.	Ref.	
25-44	31873 (41.7)	3163 (9.9)	28710 (90.1)	1.9 [1.75;2.02]	1.9 [1.76, 2.02]	
45-65	14558 (19.0)	2642 (18.1)	11916 (81.9)	3.8 [3.52;4.07]	4.0 [3.72, 4.31]	
65+	9355 (12.2)	1825 (19.5)	7530 (80.5)	4.13 [3.82;4.5]	4.5 [4.13, 4.9]	
Household size [Median (Q1; Q3)]	6.0 [3.0;15.0]	8.0 [3.0;20.0]	6.0 [3.0;15.0]	-	-	-
Missing (%column)	67928 (89)	7990 (91)	59938 (89)			
User type:						
Contributor	1004 (1.3)	173 (17.2)	831 (82.8)	-	-	-
Subsidized	62683 (82)	8603 (13.7)	54080 (86.3)			
Missing	12789 (16.7)					
Time since enrollment [a] [Median of years (Q1; Q3)]	11.3 [6.3;13.1]	10.3 [5.5;13.1]	11.3 [6.7;13.1]	-	-	<0.001[+]
Enrollment period:						<0.001
<2010	51948 (67.9)	5420 (10.4)	46528 (89.6)	Ref.	Ref.	
2010-2013	14276 (18.7)	2239 (15.7)	12037 (84.3)	1.60 [1.51;1.68]	1.7 [1.61, 1.8]	
2014-2017	10252 (13.4)	1117 (10.9)	9135 (89.1)	1.05 [0.98;1.12]	1.1 [1.03, 1.2]	
Region of residence**:						<0.001
Upper	28202 (36.9)	2729 (9.7)	25473 (90.3)	Ref.	Ref.	
Lower	5296 (6.9)	426 (8.0)	4870 (92.0)	0.82 [0.73;0.91]	0.87 [0.8, 0.97]	
Middle	42978 (56.2)	5621 (13.1)	37357 (86.9)	1.40 [1.34;1.47]	1.37 [1.3, 1.45]	
Area of residence:						<0.001
Rural	64566 (84.4)	7084 (11.0)	57482 (89.0)	Ref.	Ref.	
Urban	11910 (15.6)	1692 (14.2)	10218 (85.8)	1.34 [1.27;1.42]	1.29 [1.22, 1.4]	
Health status by 2017:						<0.001
Alive	74848 (97.9)	8315 (11.1)	66533 (88.9)	Ref.		
Dead	1628 (2.1)	461 (28.3)	1167 (71.7)	3.16 [2.83;3.53]		

Odds ratio adjusted by sex, age, enrol time, region, and zone of residence. Q: Quartile; CI: Confidence Interval; Ref: Reference category. *Exact Fisher test; Permutation Chi-square test is performed when the expected count in some cells is lower than 5; [+]Mann-Whitney U test; **La Guajira's regions (Municipalities): Middle (Maicao, Riohacha, Manaure), Lower (Albania, Barrancas, San Juan, Villanueva, Distracción), and Upper (Uribia). [a] See additional information in appendix file 2, figure 2: testing statistically significant differences in Median of years since enrollment by number of chronic conditions.

Multimorbidity Patterns in AW Indigenous Enrollees in 2014-2017

Hierarchical clustering analysis (HCA) was performed to identify multimorbidity patterns in patients with chronic conditions whose prevalence was greater than 1% amongst the total and sex-specific populations. Using the Ward method, HCA is estimated for females and males. Six models were fit, fitting models with from 2 to 7 clusters (multimorbidity patterns) in each population. Estimates for the total population considered 98.5% of multimorbid patients (n=8672) and 14 chronic conditions. The final model included five multimorbidity patterns showing better trade-offs regarding Within Cluster Sum of squares (248.8), the average distances between (0.21) and within (0.28) clusters. The most frequent cluster (Cluster # 1, n=2963) in the total population was mainly composed of patients with Chronic low back pain (50.3%), Chronic pain (57.1%), and Gastritis (24.9%). The second most prevalent pattern, Cluster # 5 (n=1612), was characterized by clustering patients suffering mainly from Hypertension (56.8%), Disorders of lipoprotein metabolism (48.1%) and Diabetes (30%) (Figure 5, see additional description in Appendix Table 22).

Figure 5. Multimorbidity patterns in the Indigenous population aged 18+ years old, 2014-2017, n= 8672

On the other hand, the number of patterns estimated for the sex-specific HCA varied by group. The female population included 99% of multimorbid patients (n=6218) and 21 chronic conditions. The final model had five multimorbidity patterns, where the most prevalent patterns included patients suffering from Chronic low back pain (46.4%), Chronic pain (47.2%), and Gastritis (39.5%) (Cluster # 1, n=41.6%). 17.4% of Females grouped in Cluster # 5 suffered from Chronic periodontitis and gingivitis (51.7%), Migraine/chronic headache (52.2%), Chronic low back pain (35.6%), and Depression (27.1%). Regarding the Male population (n=2395), HCA's final model constituted four multimorbidity patterns using data about 17 chronic conditions. Around half of the males were grouped in cluster # 1 (n=1240) who mostly suffered from Chronic low back pain (56.5%) and Chronic pain (56.9%). Cluster # 4 (n=328) grouped patients diagnosed mainly with Gastritis (100%) and Chronic low back pain (41.2%). According to sex-specific HCA findings, multimorbidity patterns in both populations are characterized by clusters in which musculoskeletal and circulatory chronic illnesses are more prevalent than other conditions (Figures 6 & 7).

Figure 6. Multimorbidity patterns in the Indigenous Female population aged 18+ years old, 2014-2017 period, n= 6218

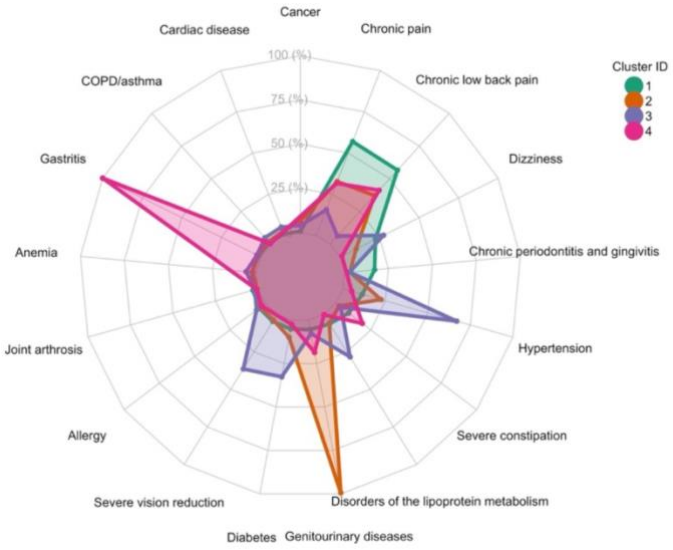


Figure 7. Multimorbidity patterns in the Indigenous Male population aged 18+ years old, 2014-2017 period, n= 2395

Appendix files provide additional information regarding HCA's findings describing estimated sex and age-specific (groups: 18-44, 45-64 and 65+ years) multimorbidity patterns. The supplementary appendix includes a summary of HCA's estimates, Dendrograms and the representations of the Elbow, Silhouette, and Gap statistic methods by sub-population (Appendix 23 to 51).

Healthcare Use in Indigenous Suffering from Multimorbidity in 2018-2019

The healthcare utilization in 2018-2019 showed statistically significant differences among the multimorbidity pattern groups identified by HCA and demographic conditions. In total, n=379 (4.4%) of clustered multimorbid patients were excluded since they died or left AW before 2018 (Appendix Table 52). Longitudinal Zero-Inflated Negative Binomial Mixed models were fitted to model the total number of healthcare services used for total, female, and male populations, as the outcome overdispersion assessment suggested. Results showed significant study outcome's zero inflation (zero-inflation test via comparison to expected zeros, ratio=

1.1024, p-value < 0.001) and overdispersion (nonparametric dispersion test, dispersion = 1.4, p-value < 0.001) (See Appendix 55 to 61, Outcome Dispersion assumption testing). In the total population, higher adjusted incidence rates of total services were observed in patients grouped in the multimorbidity clusters 3/C, 4/D, and 5/E compared to those mostly suffering from Chronic pains and Gastritis (cluster 1/A). For instance, patients with a multimorbidity pattern characterized by a high prevalence of Hypertension, Disorders of lipoprotein metabolism, Severe vision reduction and Diabetes had 4.12. times increased (Incidence Rate Ratio-IRR 95% CI= 3.4, 4.9) the average of claims compared to patients in Cluster 1/A. Differences in total claims were also observed regarding sex, age, and residence zone. The average healthcare services used increased with age compared to those aged 18-44 (65+ years; IRR: 4.2, 95% CI= 3.52, 5.17). Female indigenous enrollees and those living in urban areas (vs. rural) showed higher average claims during the following-up period. Zero-inflated model estimates also provide statistically significant differences in healthcare use. Patients who lived in the urban areas had higher odds of being among those who did not use healthcare services than those living in the rural areas (OR=1.66, 95%CI: 1.30, 2.11). The percentage of odds reduction ([1-OR] *100) decreased with age compared to the young adults (Table 4).

Multimorbidity patterns in sex-specific populations showed higher healthcare service utilization in clusters with a high prevalence of circulatory diseases, with different areas and age patients' characteristics. Female and male populations' estimates presented a greater average of claims amongst multimorbid patients suffering mostly from Hypertension and Diabetes compared to those suffering mainly from chronic pains. Service utilization rates were also higher in those living in the urban areas, with bigger differences amongst the male population. In contrast to the young adults (18-44), adjusted rates were higher in those older than 44, being greater in

Indigenous males (Table 4). Additional information regarding the mixed models' goodness-of-fit indicators, residual assumptions assessment, and the final model progressive modelling are described in Appendix files # 4 & 5.

For the 2018-2019 period, the multivariate analysis results show multimorbidity patterns that emerged among patients' subpopulations who used healthcare services. Total and sex-specific HCA similarly included two multimorbidity patterns with higher proportions of patients suffering from musculoskeletal (Cluster 1/A) and circulatory chronic illnesses (mainly conditions: Hypertension, Diabetes) (Figures 5, 6 & 7). These patterns show differential healthcare use. Multimorbidity patters' healthcare utilization rates were higher compared to that pattern clustering most patients suffering from musculoskeletal conditions (Table 4).

Additionally, females and those living in the urban area presented significantly higher healthcare use. Complementary to cross-sectional results, Indigenous enrollees in urban areas had higher use of healthcare services for multimorbidity treatment, but less use regarding the total healthcare requests. Even though findings considered AW enrollees who request healthcare, the results enable the identification of the most prevalent chronic conditions among enrollees.

Table 4. Results of mixed models fitted for Multimorbid enrollees. Outcome: Biannual counts of healthcare services used, 2018-2019

	Total			Female			Male		
Fixed effects	**IRR**	**95%CI**	**p-value**	**IRR**	**95%CI**	**p-value**	**IRR**	**95%CI**	**p-value**
Intercept	0.10	0.05, 0.18	<0.001	0.25	0.14, 0.45	<0.001	0.07	0.02, 0.31	<0.001
Rate of change (Time-Semester)	0.83	0.79, 0.87	<0.001	0.84	0.80, 0.88	<0.001	0.82	0.75, 0.89	<0.001
Multimorbidity pattern (ref: Cluster 1/A)									
Cluster 2/B	1.10	0.87, 1.39	0.408	0.98	0.73, 1.32	0.888	2.61	1.72, 3.97	<0.001
Cluster 3/C	2.73	2.21, 3.38	<0.001	9.70	7.83, 12.01	<0.001	5.12	3.63, 7.23	<0.001
Cluster 4/D	1.30	1.03, 1.63	0.028	1.87	1.50, 2.34	<0.001	0.19	0.11, 0.32	<0.001
Cluster 5/E	4.12	3.43, 4.94	<0.001	0.86	0.68, 1.10	0.243			
Area of residence (ref: Rural)									
Urban	3.36	2.84, 3.97	<0.001	2.64	2.20, 3.17	<0.001	3.72	2.63, 5.27	<0.001
User type (ref: Contributor)									
Subsidized	0.46	0.26, 0.81	0.007	0.47	0.26, 0.83	0.01	0.43	0.11, 1.70	0.228
Sex (ref: Male)									
Female	1.43	1.22, 1.67	<0.001						
Age (ref: 18 to 44 years old)									
45 to 64	2.89	2.43, 3.42	<0.001	1.88	1.56, 2.28	<0.001	4.32	2.81, 6.64	<0.001
65+	4.27	3.52, 5.17	<0.001	1.76	1.40, 2.20	<0.001	6.49	4.18, 10.08	<0.001
Zero-Inflated model	**OR**	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**
Intercept	1.05	0.58, 1.92	0.864	0.93	0.50, 1.72	0.811	1.81	0.61, 5.36	0.281
Cluster 2/B	0.93	0.57, 1.53	0.777	1.11	0.67, 1.85	0.688	1.39	0.67, 2.91	0.376
Cluster 3/C	1.28	0.90, 1.82	0.177	0.26	0.11, 0.61	0.002	1.62	0.85, 3.09	0.144
Cluster 4/D	2.29	1.57, 3.34	<0.001	1.90	1.33, 2.72	<0.001	0.19	0.01, 3.74	0.275
Cluster 5/E	1.17	0.85, 1.62	0.344	0.60	0.33, 1.09	0.095			
Area of residence: Urban	1.66	1.30, 2.11	<0.001	1.47	1.07, 2.02	0.016	1.77	1.05, 2.98	0.032
User type: Subsidized	0.38	0.23, 0.62	<0.001	0.48	0.27, 0.87	0.015	0.24	0.09, 0.67	0.006
Sex: Female	0.79	0.61, 1.02	0.076						
Age: 45 to 64	0.3	0.22, 0.40	<0.001	0.25	0.16, 0.39	<0.001	0.32	0.15, 0.70	0.005
Age: 65+	0.2	0.13, 0.29	<0.001	0.20	0.11, 0.35	<0.001	0.1	0.04, 0.27	<0.001
Random Effects									
τ_{00} (Intercept)			2.40 $_{id}$			2.1704 $_{id}$			2.3961 $_{id}$
τ_{11} (Rate of change)			0.5161 $_{id\text{-}time}$			0.5246 $_{id\text{-}time}$			0.4992 $_{id\text{-}time}$
ρ_{01} (Corr)			-0.41 $_{id}$			-0.49 $_{id}$			-0.31 $_{id}$
n			8293 $_{id}$			5983 $_{id}$			2249 $_{id}$
Observations			32220			23285			8693
BIC			61379.68			44549.81			16302.07
AIC			61204.10			44395.78			16181.99
Log Likelihood			-30577.05			-22174.89			-8069.99
Likelihood Ratio test*		945.8, df=9, p-value < 0.001			376.47, df=7, p-value < 0.001			293.26, df=7, p-value < 0.001	

IRR: Adjusted Incidence Rate Ratio; OR: Adjusted Odds Ratio; CI: Confident interval; id: it refers to each patient; df: degrees of freedom. *Model comparison versus the nested model with Multimorbidity cluster membership and Time-semester covariates, adding random intercept and slope (for Time-Semester).

Chapter 5: Discussion

Social inequalities and their negative impact on the health of communities are part of the academic and institutional agenda today. Social inequities in health refer to disparities in health outcomes due differences in opportunities related to social class, gender, territory, or ethnicity (13). According to national census estimates for La Guajira, in 2018, there were two or more municipalities with more than 65% of households facing unsatisfied basic needs. Similarly, these territories showed a lower percentage of people having sanitation systems, potable water, and energy supply (4). Systematically, social inequalities are observed in Wayuu's territory where political, social, and economic processes have had an important role in how people live and die.

The lack of empirical evidence in public health is a detriment to Colombian Indigenous peoples and has difficulted public health strategies implementation. The Pan American Health Organization (PAHO) and the Economic Commission for Latin America and the Caribbean (ECLAC) have identified certain ethnic groups as being among the most vulnerable social groups. According to PAHO, there is an evident lag in indigenous health information and official other sources in Latin American countries (9). The present study described the extent of multimorbidity clusters in a distinct Indigenous population, contributing analytical strategies for data from the Colombian National Health Care Information System (61).

This study sought to show the potential of national administrative data sources for public health research by providing information about multimorbidity and healthcare

services used by AW enrollees. According to healthcare utilization estimates, access to healthcare was less frequent among Indigenous males and those who lived in rural areas. Similarly, empirical evidence regarding social inequalities in health in Colombia highlights the axes of inequality that significantly influence health outcomes. Compared to women, men have a greater risk of dying from external causes and suffering chronic conditions and more difficulties in accessing the healthcare system (59). Based on the present research findings, the period prevalence of multimorbidity among Indigenous enrollees was nearly 8.2% (95%CI: 8.0, 8.3) but rising through age groups. A nationwide population-based study using AHR indicated that, on average, 19.5% of people had multimorbidity in Colombia in 2012-2016 (37). That study showed that the prevalence of multimorbidity among the 18-59 years-old population was 33.1%, while those older than 60 were 51.3% (37). The study did not intend to estimate the prevalence among Wayuu people; however, the magnitude of this indicator could suggest the magnitude of the phenomenon based on the significant patient sample. Nevertheless, multimorbidity prevalence estimations must be carefully interpreted since patterns of healthcare use were observed among enrollees considering their sex, area of residence and year of enrollment.

Other studies on multimorbidity have focused on estimating its prevalence, describing patterns, and exploring its statistical association with socioeconomic factors. In Canada, studies have mainly used three primary data sources (35,60–63). For example, a study using the Canadian Chronic Disease Surveillance System, which structured administrative data from ten provinces and territories in 2015, including Manitoba, found that the estimated age-standardized prevalence of multimorbidity among Canadians aged 40 years and over in 2011/12 was 26.5%, a relative increase of 29.3% compared to the fiscal

year 2001/02 prevalence (20.5%). In Manitoba, the relative increase in prevalence was even higher, from 20.4% in 2001/02 to 27.7% in 2011/12 (35).

Scientific evidence from analyses of the Canadian Longitudinal Study on Aging (CLSA) survey baseline data showed that, in the 2010-2015 period, multimorbidity (3+ chronic conditions) became more common as people got older, rising from 29.7% in the 45–49-year-old age group to 52% among those aged 60–64 years. Among Manitobans, the prevalence of multimorbidity was 37.4% (99%CI: 34.7, 40.2) (61). Another study found that lower levels of education and household incomes showed higher odds of suffering multimorbidity among all age groupings. Compared to those having a post-bachelor's degree, the odds of multimorbidity in Canadians aged 65 years and over with incomplete high school level was 1.43 (95%CI:1.15, 1.76). People younger than 65 years old and whose individual income was <$20,000 per year showed higher odds of multimorbidity compared to those whose incomes were higher than $99.999 per year (OR=3.76, [95%CI: 3.20, 4.39]) (60).

Evidence from studies based on the cross-sectional population Community Health Survey (CCHS) data can be observed in Canada. Results of analyses of the 2011/12 CCHS cycle showed that 12.9% (95%CI: 12.6, 13.2) of Canadians older than 19 years suffered from multimorbidity. Higher prevalence was observed among Aboriginals, 65 years and older, and those in the lowest household income quintile (62). A recently published study analyzing the 2015–2018 cycle data suggests a cross-sectional prevalence of multimorbidity of 8.1% among Canadians aged 20 years and over residing in the 35 census metropolitan areas. Results about ethnicity, age, and income and how it relates to multimorbidity were consistent with those reported for the 2011/12 cycle (63).

On the other hand, the present study suggests AHR structuring and extraction processes contributing to AW's healthcare services research and data sovereignty. Data sovereignty for Indigenous peoples considers their right to own, control, access and possess data relating to their community, knowledge, practices, or territory (64). Obtaining evidence about multimorbidity may contribute to Indigenous data governance by obtaining evidence for healthcare planning and delivery at AW. Multimorbidity information might help to allocate resources and estimate healthcare costs within the healthcare system at the Indigenous community level. Study findings and the proposed methodology may foster further research focusing on the effect of multimorbidity on healthcare utilization.

This study may also contribute to the scientific knowledge about multimorbidity and provide information for strengthening patient safety in AW. In multimorbidity, diseases may interact with each other, either in pathophysiology or clinical care. Multimorbid patients frequently require extensive and continued treatment. These interactions have an impact on safety in health care. Patient safety events may involve adverse reactions and inappropriate prescribing (26,29,31). Even though specific-disease clinical guidelines indicate when patients should receive medications, it mostly fails to suggest when to stop the prescriptions (65). The cumulative drug burden among these patients is problematic and hazardous (66,67). The interactions and numerous treatments in multimorbidity and adverse socioeconomic conditions can cause significant patient safety encounters at any stage of life (26,29,31).

The present study would permit AW to establish more rigorous data processing and analysis, providing scientific evidence for the decision-making process at the policy level in Colombia (68) regarding the healthcare system and social reforms in La Guajira. Findings

about AW Indigenous enrollees offer information about specific healthcare use and epidemiological profiles, which can support communities in demanding improved social conditions and healthcare delivery. Study results may contribute to increasing knowledge about the community's health and providing information for the national agenda regarding a new intercultural healthcare system implementation.

Study Strengths and Limitations

This study has potential strengths. Findings may support the healthcare delivery processes by identifying multimorbid patient groups from AW requiring systematic health monitoring. It could also contribute to developing methodological strategies in Colombia regarding healthcare use among patients suffering from chronic conditions. Study methods can be systematically applied in all national territories to establish epidemiological profiles considering social determinants of health such as ethnicity, social class, sex, and zone of residence. In addition, the study may suggest a way to maximize the value of public and private investments in health information systems since it uses open-access data to explore population morbidity through administrative data management processes. The data management plan implemented proposed a way to monitor multimorbidity using AHR as an opportunity to link them to the census and nationwide survey data, thus, performing robust data analysis and contributing to the Situation Health Status monitoring in Colombia.

Some possible biases could have influenced study results. First, diseases may be underreported, particularly among working-age people who see their doctors less frequently than other patient groups (69). Patients seeking care are more likely to receive a medical diagnosis; thus, data about healthcare utilization only includes information from

those who requested and used a service. Some disease clusters are more common among patients seeking healthcare than the general population (26). The most recommended strategy for avoiding this bias is to use a community sample instead of enrollee data. Despite that the clustering analyses are fitted following recommended statistical estimation protocols, multimorbidity patterns might require clinical consistency validation with health practitioners from AW before empirical evidence use. Regarding study estimates, potential residual confounding of multivariable data analysis estimates might be observed because of data missingness, and risk factors whose data were unavailable for the study population.

Conclusion

The study provided evidence about multimorbidity and healthcare use in an Indigenous population in Colombia. Study findings described multimorbidity patterns amongst Indigenous Wayuu patients, which may help formulate new research questions to clinically evaluate the emerging chronic morbidity profiles. Most AW multimorbid enrollees clustered in patient groups had a higher prevalence of circulatory and musculoskeletal chronic diseases. Healthcare use estimates provided an account of differences in AW enrollees regarding areas of residence and sex; however, the interpretation of these results should consider the specificity of multimorbid patient services utilization. Results are not generalizable to other indigenous groups in Colombia. The study sought to strengthen AW's data governance and healthcare delivery model using administrative data from routine data collection processes implemented in the Colombian healthcare system.

Appendices

Appendix 1. Selected chronic conditions for cases identification according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)

Chronic condition	ICD-10 Subcategories codes
Allergy	H011, J300, J301, J302, J303, J304, K522, K900, L230, L231, L232, L233, L234, L235, L236, L237, L238, L239, L272, T781, T784, T887
Anemia	D500, D501, D508, D509, D510, D511, D513, D518, D519, D520, D521, D528, D529, D530, D531, D538, D539, D550, D551, D561, D563, D569, D570, D571, D573, D578, D580, D581, D582, D588, D589, D590, D591, D592, D593, D594, D598, D599, D608, D609, D610, D612, D613, D618, D619, D630, D638, D640, D641, D643, D648, D649
Anxiety	F400, F401, F402, F408, F409, F410, F411, F412, F413, F418, F419, F420, F422, F428, F429
Arthritis	L930, M052, M053, M058, M059, M060, M061, M062, M063, M068, M069, M070, M071, M074, M080, M082, M083, M088, M089, M100, M101, M103, M104, M109, M110, M111, M119, M121, M123, M124, M125, M128, M130, M131, M138, M139, M140, M145, M146, M148, M201, M232, M239, M300, M313, M315, M329, M793, M794, M795, M798, M799
Brain infarction/hemorrhage	G451, G452, G453, G458, G459, I600, I601, I602, I603, I604, I606, I607, I608, I609, I610, I611, I612, I613, I614, I615, I616, I619, I620, I621, I629, I630, I631, I633, I634, I635, I638, I639, I64X, I690, I691, I692, I693, I694, I698
Cancer	C000, C005, C008, C01X, C020, C022, C028, C029, C039, C040, C041, C048, C049, C050, C051, C058, C060, C068, C069, C07X, C080, C081, C088, C098, C099, C101, C102, C103, C104, C108, C109, C110, C112, C113, C118, C119, C139, C140, C148, C150, C151, C152, C154, C155, C158, C159, C161, C162, C163, C165, C169, C180, C182, C183, C184, C186, C187, C188, C189, C20X, C210, C211, C218, C220, C221, C229, C23X, C240, C241, C248, C249, C250, C251, C252, C254, C257, C258, C259, C269, C323, C328, C329, C340, C341, C342, C343, C348, C349, C37X, C431, C433, C437, C438, C439, C480, C482, C488, C490, C491, C492, C494, C495, C496, C498, C499, C500, C501, C502, C503, C504, C505, C506, C508, C509, C530, C531, C538, C539, C540, C541, C542, C543, C548, C549, C55X, C56X, C61X, C64X, C65X, C66X, C672, C673, C674, C675, C678, C679, C710, C711, C712, C713, C715, C716, C717, C718, C719, C73X, C749, C750, C751, C755, C759, C762, C770, C772, C774, C779, C780, C784, C786, C787, C790, C792, C793, C795, C796, C798, C810, C811, C812, C817, C819, C820, C821, C822, C827, C829, C830, C832, C833, C836, C838, C839, C840, C843, C845, C850, C851, C857, C859, C900, C901, C902, C910, C911, C912, C917, C919, C920, C921, C922, C923, C924, C927, C929, C931, C941, C947, C950, C957, C959, C960, C961, C967, C969, D000, D001, D002, D010, D011, D012,

Chronic condition	ICD-10 Subcategories codes
	D013, D014, D015, D019, D020, D022, D023, D033, D035, D037, D038, D039, D040, D041, D043, D044, D045, D046, D047, D048, D049, D051, D057, D059, D060, D061, D067, D069, D070, D071, D072, D073, D074, D075, D076, D090, D091, D093, D097, D099, D370, D371, D373, D374, D375, D376, D377, D379, D380, D381, D382, D383, D386, D390, D391, D397, D399, D400, D401, D407, D409, D410, D411, D412, D413, D414, D417, D419, D420, D421, D429, D430, D431, D432, D433, D434, D437, D439, D440, D441, D442, D443, D444, D445, D45X, D460, D462, D464, D467, D469, D470, D471, D473, D477, D479, D480, D481, D482, D483, D484, D485, D486, D487, D489
Cardiac disease	I062, I080, I081, I082, I088, I089, I099, I200, I201, I208, I209, I210, I211, I212, I213, I214, I219, I238, I250, I251, I252, I253, I254, I255, I256, I258, I259, I260, I269, I270, I279, I340, I341, I342, I349, I350, I351, I352, I358, I359, I361, I368, I369, I370, I371, I372, I378, I379, I420, I421, I422, I425, I428, I429, I430, I440, I441, I442, I443, I444, I445, I446, I447, I450, I451, I452, I453, I454, I455, I456, I458, I459, I460, I469, I470, I471, I472, I479, I490, I491, I495, I498, I499, I500, I501, I509, I510, I512, I513, I514, I517, I518, I519, Z950, Z952, Z954
Chronic cholecystitis/gallstones	K800, K801, K802, K803, K804, K805, K808
Chronic kidney disease	I823, N030, N038, N039, N083, N110, N111, N118, N119, N180, N188, N189, N19X, N251, Z940, Z992
Chronic low back pain	M401, M402, M404, M405, M45X, M471, M472, M478, M479, M480, M482, M489, M500, M501, M502, M503, M508, M509, M540, M541, M542, M543, M544, M545, M546, M548
Chronic pain	F454, M255, M432, M434, M435, M436, M461, M469, M510, M511, M512, M513, M514, M518, M531, M532, M533, M538, M539, M609, M790, M791, M792, M796, M797
Chronic periodontitis and gingivitis	K045, K051, K053
Chronic sinusitis	J320, J321, J322, J323, J324, J328, J329
Colitis ulcerous/Chron´s disease	K500, K501, K508, K509, K510, K511, K512, K513, K514, K515, K518, K519, K571, K572, K573, K574, K575, K578, K579
COPD/asthma	J40X, J410, J411, J418, J42X, J432, J438, J439, J440, J441, J448, J449, J450, J451, J458, J459, J47X, J841, J849, J961
Delirium	F050, F058, F059
Dementia	F000, F001, F002, F009, F010, F011, F012, F013, F018, F019, F023, F024, F028, F03X, F051, G300, G301, G308, G309, G310, G318, G319
Depression	F320, F321, F322, F323, F328, F329, F330, F331, F332, F333, F334, F338, F339, F341, F348
Diabetes	E100, E101, E102, E103, E104, E105, E106, E107, E108, E109, E110, E111, E112, E113, E114, E115, E116, E117, E118, E119, E120, E121, E122, E123, E124, E125, E126, E127, E129, E131, E132, E133, E134, E135,

Chronic condition	ICD-10 Subcategories codes
	E136, E137, E138, E139, E140, E141, E142, E143, E144, E145, E146, E147, E148, E149, E15X, E161, E162, H360
Disorders of the eyes and ears	H420, H428, H445, H801, H802, H808
Disorders of the lipoprotein metabolism	E780, E781, E782, E783, E784, E785, E786, E788, E789, I652, I662, I668, I672, I700, I701, I702, I708, I709, I710, I712, I714, I715, I716, I718, I719, I729, I738, I739, I741, I742, I743, I744, I748, I749
Dizziness	H810, H811, H812, H813, H814, H819, H82X, R42X
Epilepsy	G400, G401, G402, G403, G404, G405, G406, G408, G409
Gastritis	K210, K219, K221, K222, K254, K256, K257, K259, K264, K265, K267, K269, K277, K279, K287, K289, K292, K293, K294, K295
Genitourinary diseases	N200, N201, N202, N209, N393, N394, N40X, N411, N810, N811, N812, N813, N814, N815, N816, N818, N819, N841, N842, N843, N848, N849, N850, N851, N852, N853, N854, N856, N857, N858, N859, N86X, N870, N871, N872, N879, N880, N881, N883, N888, N889, N890, N891, N892, N893, N894, N895, N897, N898, N899, N901, N902, N903, N904, N905, N906, N907, N908, N909, N930, N938, N939, N950, N951, N952, N953, N958, N959, R32X
Hemorrhoids	I840, I841, I842, I843, I844, I845, I846, I847, I848, I849
Human Immunodeficiency Virus	B200, B201, B203, B204, B205, B206, B207, B208, B209, B219, B220, B222, B227, B230, B231, B232, B238, B24X
Hypertension	I10X, I110, I119, I120, I129, I130, I131, I132, I139, I150, I151, I152, I158, I159
Hypotension	I950, I951, I952, I958, I959
Joint arthrosis	M150, M151, M152, M153, M154, M158, M159, M160, M161, M162, M163, M164, M165, M167, M169, M170, M171, M172, M173, M174, M175, M179, M181, M182, M185, M189, M190, M191, M192, M198, M199
Liver (gallbladder) and pancreas disease	K717, K721, K738, K739, K740, K743, K744, K745, K746, K758, K761, K766, K767, K778, K830, K861, K862, K863, K868, K869, K870
Malnutrition and cachexia	E41X, E42X, E441, E46X, R64X
Mental and behavioral disorders	F200, F201, F203, F204, F205, F206, F208, F209, F220, F250, F251, F252, F259, F29X, F310, F311, F312, F313, F314, F315, F316, F317, F318, F319, F99X
Mental disorders due to alcohol	F101, F102, F103, F104, F105, F106, F108, F109, G312, K700, K703, K709, K860
Mental disorders due to tobacco	F170
Migraine/chronic headache	G430, G431, G432, G438, G439, G440, G441, G442, G443, G444, G448
Multiple sclerosis	G35X, G360, G368, G369, G370, G373, G378, G379, H46X

Chronic condition	ICD-10 Subcategories codes
Neuropathy	G500, G501, G508, G509, G510, G511, G513, G514, G518, G519, G520, G521, G522, G528, G530, G531, G532, G533, G540, G541, G542, G543, G544, G545, G546, G548, G549, G551, G552, G553, G558, G560, G561, G563, G564, G568, G569, G570, G571, G573, G574, G575, G576, G578, G579, G580, G587, G588, G589, G590, G598, G603, G609, G610, G611, G618, G619, G620, G621, G628, G629, G631, G632, G633, G634, G636, G638, G64X, G990
Obesity	E660, E661, E662, E668, E669
Osteoporosis/osteoarthrosis	M431, M465, M468, M481, M484, M488, M490, M492, M519, M800, M802, M803, M805, M808, M809, M810, M811, M812, M813, M815, M816, M818, M819, M820, M821, M828, S336
Parathyroidism	E200, E209, E210, E211, E213
Parkinson disease	G20X, G210, G211, G218, G219, G22X
Psoriasis	L400, L401, L402, L403, L404, L405, L408, L409
Senility	R54X
Severe constipation	K558, K560, K564, K567, K590, K631, K634, K638, K928
Severe hearing loss	H900, H901, H902, H903, H904, H905, H906, H907, H908, H910, H913, H918, H919, H933, H938
Severe vision reduction	H170, H171, H178, H179, H180, H181, H182, H183, H184, H185, H186, H187, H188, H189, H250, H251, H252, H258, H259, H260, H262, H263, H264, H268, H269, H270, H310, H313, H318, H319, H330, H331, H332, H333, H334, H341, H342, H348, H349, H359, H368, H430, H431, H432, H433, H438, H439, H470, H471, H472, H473, H475, H476, H540, H541, H542, H543, H544, H545, H546
Sexual dysfunction	F520, F521, F522, F523, F524, F525, F526, F527, F528, F529, N484
Sleep disorder	F510, F511, F512, F513, F515, F518, F519, G470, G471, G472, G473, G474, G478, G479
Thyroid dysfunction	E010, E011, E012, E018, E02X, E030, E031, E032, E033, E038, E039, E040, E041, E042, E048, E049, E050, E051, E052, E055, E058, E059, E060, E061, E063, E065, E069, E071, E078, E079
Tuberculosis	A150, A151, A152, A153, A154, A155, A156, A157, A158, A159
Ulcer of the skin	L984
Vitamin-D deficiency	E559

Appendix 2 - Table. Consistency in physician visits Claims by data set features, 2014-2019, n=3555082
Column percentages are computed unless otherwise specified

Feature	Total *N=3555082*	2014 *N=134505*	2015 *N=419479*	2016 *N=590410*	2017 *N=700184*	2018 *N=840395*	2019 *N=870109*
Main diagnosis (ICD10 chapter):							
Certain Conditions Originating in the Perinatal Period	4255 (0.1)	392 (0.3)	926 (0.2)	880 (0.1)	539 (0.1)	654 (0.1)	864 (0.1)
Certain Infectious and Parasitic Diseases	155466 (4.4)	8137 (6.0)	21465 (5.1)	21563 (3.7)	27295 (3.9)	36893 (4.4)	40113 (4.6)
Congenital Malformation, Deformations, and Chromosomal Abnormalities	7288 (0.2)	328 (0.2)	765 (0.2)	838 (0.1)	1433 (0.2)	1728 (0.2)	2196 (0.3)
Diseases of the Blood and Blood Forming Organs and Certain Disorders Involving the Immune Mechanism	13135 (0.4)	606 (0.5)	1910 (0.5)	1928 (0.3)	2264 (0.3)	3069 (0.4)	3358 (0.4)
Diseases of the Circulatory System	187546 (5.3)	4627 (3.4)	23116 (5.5)	27061 (4.6)	41082 (5.9)	46802 (5.6)	44858 (5.2)
Diseases of the Digestive System	297400 (8.4)	9606 (7.1)	36784 (8.8)	36900 (6.2)	58751 (8.4)	80507 (9.6)	74852 (8.6)
Diseases of the Ear and Mastoid Process	24193 (0.7)	957 (0.7)	4958 (1.2)	4316 (0.7)	5056 (0.7)	4386 (0.5)	4520 (0.5)
Diseases of the Eye and Adnexa	59903 (1.7)	3504 (2.6)	7559 (1.8)	7756 (1.3)	12251 (1.7)	13227 (1.6)	15606 (1.8)
Diseases of the Genitourinary System	141256 (4.0)	5811 (4.3)	18261 (4.4)	19494 (3.3)	27446 (3.9)	32993 (3.9)	37251 (4.3)
Diseases of the Musculoskeletal System and Connective Tissue	88320 (2.5)	3907 (2.9)	12355 (2.9)	11008 (1.9)	16266 (2.3)	20436 (2.4)	24348 (2.8)
Diseases of the Nervous System	30916 (0.9)	1028 (0.8)	2409 (0.6)	3538 (0.6)	5957 (0.9)	8270 (1.0)	9714 (1.1)
Diseases of the Respiratory System	343481 (9.7)	11991 (8.9)	39786 (9.5)	51487 (8.7)	67950 (9.7)	86435 (10.3)	85832 (9.9)
Diseases of the Skin and Subcutaneous Tissue	76060 (2.1)	2256 (1.7)	9039 (2.2)	9552 (1.6)	15566 (2.2)	18838 (2.2)	20809 (2.4)
Endocrine, Nutritional, and Metabolic Disorders	84203 (2.4)	4289 (3.2)	12040 (2.9)	13351 (2.3)	15578 (2.2)	18544 (2.2)	20401 (2.3)
External Causes of Morbidity and Mortality	5450 (0.2)	368 (0.3)	574 (0.1)	619 (0.1)	1108 (0.2)	1365 (0.2)	1416 (0.2)
Factors influencing Health Status and Contact with Health Services	1571723 (44.2)	43365 (32.2)	165883 (39.5)	318995 (54.0)	313292 (44.7)	354202 (42.1)	375986 (43.2)
Injury, Poisoning, and Certain Other Consequences of External Causes	47966 (1.3)	2649 (2.0)	5907 (1.4)	6130 (1.0)	10083 (1.4)	11743 (1.4)	11454 (1.3)
Mental and Behavioral Disorders	22449 (0.6)	528 (0.4)	1467 (0.3)	2392 (0.4)	4614 (0.7)	6259 (0.7)	7189 (0.8)
Neoplasms	21362 (0.6)	1135 (0.8)	1719 (0.4)	2645 (0.4)	3898 (0.6)	6479 (0.8)	5486 (0.6)
Pregnancy, Childbirth, and the Puerperium	26915 (0.8)	2392 (1.8)	3432 (0.8)	3377 (0.6)	4898 (0.7)	6247 (0.7)	6569 (0.8)
Symptoms, Signs, and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified	345787 (9.7)	26621 (19.8)	49124 (11.7)	46580 (7.9)	64857 (9.3)	81318 (9.7)	77287 (8.9)
'Missing'	8 (<0.1)	8 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Inconsistent diagnosis data values:							
C730	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
MI39	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
N64G	3 (<0.1)	3 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
NG21	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Q837	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
ZGG8	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Physician visit purpose:							
Delivery care	3113 (0.1)	395 (0.3)	476 (0.1)	492 (0.1)	569 (0.1)	384 (<0.1)	797 (0.1)
Newborn care	193 (<0.1)	28 (<0.1)	4 (<0.1)	38 (<0.1)	43 (<0.1)	39 (<0.1)	41 (<0.1)
Family planning	535082 (15.1)	5022 (3.7)	31283 (7.5)	140804 (23.8)	133012 (19.0)	119736 (14.2)	105225 (12.1)
Physiological disorder detection among 0-10 years-old population	378345 (10.6)	11468 (8.5)	46402 (11.1)	62554 (10.6)	71760 (10.2)	84963 (10.1)	101198 (11.6)
Physiological disorder detection among young population	140603 (4.0)	4088 (3.0)	11690 (2.8)	18978 (3.2)	21779 (3.1)	37299 (4.4)	46769 (5.4)
Pregnancy disorder detection	119366 (3.4)	1929 (1.4)	12204 (2.9)	16845 (2.9)	23847 (3.4)	32104 (3.8)	32437 (3.7)
Physiological disorder detection among elderly population	51809 (1.5)	1195 (0.9)	2201 (0.5)	2478 (0.4)	4251 (0.6)	5405 (0.6)	36279 (4.2)
Visual disturbances detection	26531 (0.7)	361 (0.3)	1181 (0.3)	5388 (0.9)	5957 (0.9)	7547 (0.9)	6097 (0.7)
Occupational disease detection	1192 (<0.1)	22 (<0.1)	80 (<0.1)	51 (<0.1)	70 (<0.1)	328 (<0.1)	641 (0.1)

Feature	Total *N=3555082*	2014 *N=134505*	2015 *N=419479*	2016 *N=590410*	2017 *N=700184*	2018 *N=840395*	2019 *N=870109*
Not applicable	2298848 (64.7)	109997 (81.8)	313958 (74.8)	342782 (58.1)	438896 (62.7)	552590 (65.8)	540625 (62.1)
External cause:							
Accident at work	224 (<0.1)	16 (<0.1)	26 (<0.1)	32 (<0.1)	80 (<0.1)	43 (<0.1)	27 (<0.1)
Traffic accident	127 (<0.1)	6 (<0.1)	19 (<0.1)	13 (<0.1)	36 (<0.1)	24 (<0.1)	29 (<0.1)
Rabies accident	115 (<0.1)	4 (<0.1)	25 (<0.1)	11 (<0.1)	17 (<0.1)	20 (<0.1)	38 (<0.1)
Ophidian accident	17 (<0.1)	1 (<0.1)	1 (<0.1)	0 (0.0)	3 (<0.1)	4 (<0.1)	8 (<0.1)
Other accident	677 (<0.1)	89 (0.1)	51 (<0.1)	61 (<0.1)	142 (<0.1)	128 (<0.1)	206 (<0.1)
Catastrophic accident	80 (<0.1)	42 (<0.1)	33 (<0.1)	0 (0.0)	1 (<0.1)	0 (0.0)	4 (<0.1)
Assault	192 (<0.1)	5 (<0.1)	18 (<0.1)	25 (<0.1)	39 (<0.1)	57 (<0.1)	48 (<0.1)
Self-inflected injury	28 (<0.1)	1 (<0.1)	6 (<0.1)	3 (<0.1)	2 (<0.1)	10 (<0.1)	6 (<0.1)
Physical abuse suspicion	30 (<0.1)	0 (0.0)	5 (<0.1)	3 (<0.1)	7 (<0.1)	5 (<0.1)	10 (<0.1)
Sexual abuse suspicion	392 (<0.1)	11 (<0.1)	10 (<0.1)	53 (<0.1)	39 (<0.1)	22 (<0.1)	257 (<0.1)
Sexual violence suspicion	53 (<0.1)	3 (<0.1)	3 (<0.1)	9 (<0.1)	17 (<0.1)	14 (<0.1)	7 (<0.1)
Emotional violence suspicion	429 (<0.1)	17 (<0.1)	17 (<0.1)	14 (<0.1)	138 (<0.1)	124 (<0.1)	119 (<0.1)
General illness	2425181 (68.2)	104004 (77.3)	319369 (76.1)	339419 (57.5)	477731 (68.2)	592505 (70.5)	592153 (68.1)
Occupational illness	774 (<0.1)	21 (<0.1)	59 (<0.1)	92 (<0.1)	233 (<0.1)	186 (<0.1)	183 (<0.1)
Other diseases	1126763 (31.7)	30285 (22.5)	99837 (23.8)	250675 (42.5)	221699 (31.7)	247253 (29.4)	277014 (31.8)
Diagnosis type:							
Diagnostic impression	2914070 (82.0)	106600 (79.3)	341208 (81.3)	507649 (86.0)	567998 (81.1)	667851 (79.5)	722764 (83.1)
New and confirmed	435932 (12.3)	18106 (13.5)	50857 (12.1)	51817 (8.8)	91353 (13.0)	122705 (14.6)	101094 (11.6)
Repeated and confirmed	205080 (5.8)	9799 (7.3)	27414 (6.5)	30944 (5.2)	40833 (5.8)	49839 (5.9)	46251 (5.3)
Total visit cost [Mean of COP (SD)]	17071.0 (567652.3)	27267.9 (348920.3)	37234.8 (1447561.9)	14594.0 (648997.0)	26560.9 (19793.7)	7932.6 (19797.0)	8644.3 (24462.4)
Net visit cost [Mean of COP (SD)]	16676.5 (571788.1)	27302.0 (349014.6)	37233.7 (1447879.5)	14657.3 (651370.2)	26529.6 (19773.1)	6978.2 (17021.4)	7438.3 (21997.3)

Missing data in physician visits Claims dataset features, 2014-2019, n-Claims=3555082

Feature	Total *N=3555082*	2014 *N=134505*	2015 *N=419479*	2016 *N=590410*	2017 *N=700184*	2018 *N=840395*	2019 *N=870109*	p-value
Main diagnosis	8 (0.00)	8 (0.01)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Physician visit purpose	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
External cause	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Diagnosis type	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Total visit cost	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Net visit cost	51789 (1.46)	72 (0.05)	184 (0.04)	4298 (0.73)	953 (0.14)	15209 (1.81)	31073 (3.57)	0.000

Appendix 3 - Table. Consistency in Emergency visits Claims records by data set features, 2014-2019, n=249632
Column percentages are computed unless otherwise specified

Feature	Total *N=249632*	2014 *N=24008*	2015 *N=29714*	2016 *N=32469*	2017 *N=47102*	2018 *N=57477*	2019 *N=58862*
External cause:							
Sexual abuse suspicion	27 (<0.1)	0 (0.0)	3 (<0.1)	3 (<0.1)	7 (<0.1)	6 (<0.1)	8 (<0.1)
Sexual violence suspicion	33 (<0.1)	1 (<0.1)	4 (<0.1)	3 (<0.1)	8 (<0.1)	11 (<0.1)	6 (<0.1)
Emotional violence suspicion	4905 (2.0)	13 (0.1)	237 (0.8)	449 (1.4)	971 (2.1)	1542 (2.7)	1693 (2.9)
General illness	241970 (96.9)	23653 (98.5)	28972 (97.5)	31633 (97.4)	45573 (96.8)	55451 (96.5)	56688 (96.3)
Occupational illness	113 (<0.1)	6 (<0.1)	0 (0.0)	8 (<0.1)	19 (<0.1)	14 (<0.1)	66 (0.1)
Other diseases	1729 (0.7)	210 (0.9)	299 (1.0)	237 (0.7)	341 (0.7)	338 (0.6)	304 (0.5)
'Missing'	855 (0.3)	125 (0.5)	199 (0.7)	136 (0.4)	183 (0.4)	115 (0.2)	97 (0.2)
Referred to:							
Emergency discharge	221237 (88.6)	21650 (90.2)	26600 (89.5)	29451 (90.7)	41407 (87.9)	50491 (87.8)	51638 (87.7)
Referred to more complex treatment level	3776 (1.5)	341 (1.4)	346 (1.2)	363 (1.1)	778 (1.7)	915 (1.6)	1033 (1.8)
Hospitalization	24619 (9.9)	2017 (8.4)	2768 (9.3)	2655 (8.2)	4917 (10.4)	6071 (10.6)	6191 (10.5)
Status:							
Alive	249380 (99.9)	23989 (99.9)	29685 (99.9)	32423 (99.9)	47061 (99.9)	57430 (99.9)	58792 (99.9)
Death	252 (0.1)	19 (0.1)	29 (0.1)	46 (0.1)	41 (0.1)	47 (0.1)	70 (0.1)
Main diagnosis (ICD10 chapter):							
Certain Conditions Originating in the Perinatal Period	959 (0.4)	113 (0.5)	141 (0.5)	162 (0.5)	155 (0.3)	181 (0.3)	207 (0.4)
Certain Infectious and Parasitic Diseases	23250 (9.3)	1826 (7.6)	2460 (8.3)	2855 (8.8)	3331 (7.1)	6370 (11.1)	6408 (10.9)
Congenital Malformation, Deformations, and Chromosomal Abnormalities	123 (<0.1)	3 (<0.1)	21 (0.1)	19 (0.1)	23 (<0.1)	28 (<0.1)	29 (<0.1)
Diseases of the Blood and Blood Forming Organs and Certain Disorders Involving the Immune Mechanism	947 (0.4)	71 (0.3)	133 (0.4)	103 (0.3)	158 (0.3)	224 (0.4)	258 (0.4)
Diseases of the Circulatory System	4926 (2.0)	591 (2.5)	676 (2.3)	649 (2.0)	867 (1.8)	936 (1.6)	1207 (2.1)
Diseases of the Digestive System	12538 (5.0)	1660 (6.9)	1917 (6.5)	2074 (6.4)	2101 (4.5)	2332 (4.1)	2454 (4.2)
Diseases of the Ear and Mastoid Process	2895 (1.2)	271 (1.1)	361 (1.2)	415 (1.3)	604 (1.3)	603 (1.0)	641 (1.1)
Diseases of the Eye and Adnexa	1064 (0.4)	85 (0.4)	157 (0.5)	131 (0.4)	254 (0.5)	254 (0.4)	183 (0.3)
Diseases of the Genitourinary System	18138 (7.3)	1724 (7.2)	2204 (7.4)	2395 (7.4)	3284 (7.0)	3946 (6.9)	4585 (7.8)
Diseases of the Musculoskeletal System and Connective Tissue	11144 (4.5)	1114 (4.6)	1248 (4.2)	1251 (3.9)	1899 (4.0)	2644 (4.6)	2988 (5.1)
Diseases of the Nervous System	3819 (1.5)	514 (2.1)	635 (2.1)	598 (1.8)	562 (1.2)	745 (1.3)	765 (1.3)
Diseases of the Respiratory System	34008 (13.6)	3236 (13.5)	4022 (13.5)	5130 (15.8)	6584 (14.0)	7425 (12.9)	7611 (12.9)

Feature	Total *N=249632*	2014 *N=24008*	2015 *N=29714*	2016 *N=32469*	2017 *N=47102*	2018 *N=57477*	2019 *N=58862*
Diseases of the Skin and Subcutaneous Tissue	5248 (2.1)	401 (1.7)	513 (1.7)	593 (1.8)	1132 (2.4)	1294 (2.3)	1315 (2.2)
Endocrine, Nutritional, and Metabolic Disorders	3076 (1.2)	410 (1.7)	354 (1.2)	411 (1.3)	377 (0.8)	511 (0.9)	1013 (1.7)
External Causes of Morbidity and Mortality	2690 (1.1)	209 (0.9)	299 (1.0)	373 (1.1)	626 (1.3)	605 (1.1)	578 (1.0)
Factors influencing Health Status and Contact with Health Services	5558 (2.2)	568 (2.4)	1019 (3.4)	989 (3.0)	1451 (3.1)	729 (1.3)	802 (1.4)
Injury, Poisoning, and Certain Other Consequences of External Causes	17249 (6.9)	1575 (6.6)	2153 (7.2)	2221 (6.8)	3568 (7.6)	3948 (6.9)	3784 (6.4)
Mental and Behavioral Disorders	738 (0.3)	71 (0.3)	104 (0.4)	84 (0.3)	125 (0.3)	157 (0.3)	197 (0.3)
Neoplasms	1127 (0.5)	67 (0.3)	132 (0.4)	169 (0.5)	239 (0.5)	300 (0.5)	220 (0.4)
Pregnancy, Childbirth, and the Puerperium	18693 (7.5)	1713 (7.1)	2028 (6.8)	2249 (6.9)	3704 (7.9)	4395 (7.6)	4604 (7.8)
Symptoms, Signs, and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified	81442 (32.6)	7786 (32.4)	9137 (30.7)	9598 (29.6)	16058 (34.1)	19850 (34.5)	19013 (32.3)

Missing data in emergency visits Claims data set features, 2014-2019, n=249632

Feature	Total *N=249632*	2014 *N=24008*	2015 *N=29714*	2016 *N=32469*	2017 *N=47102*	2018 *N=57477*	2019 *N=58862*	p-value*
External cause	855 (0.34)	125 (0.52)	199 (0.67)	136 (0.42)	183 (0.39)	115 (0.20)	97 (0.16)	<0.001
Referral	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Status	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Main diagnosis	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.

*Permutation Chi-square test is performed when the expected count in some cells is lower than 5.

Appendix 4 - Table. Consistency in Hospitalization Claims by data set features, 2014-2019, n=118941
Column percentages are computed unless otherwise specified

Feature	Total *N=118941*	2014 *N=21245*	2015 *N=25163*	2016 *N=14380*	2017 *N=16911*	2018 *N=20738*	2019 *N=20504*
Referral:							
Emergency	99988 (84.1)	19173 (90.2)	22753 (90.4)	12115 (84.2)	13878 (82.1)	16088 (77.6)	15981 (77.9)
Consultation	10821 (9.1)	1226 (5.8)	1458 (5.8)	1380 (9.6)	1722 (10.2)	2774 (13.4)	2261 (11.0)
Referred from other healthcare institution	6985 (5.9)	779 (3.7)	816 (3.2)	673 (4.7)	1061 (6.3)	1623 (7.8)	2033 (9.9)
Newborn	617 (0.5)	67 (0.3)	92 (0.4)	102 (0.7)	134 (0.8)	130 (0.6)	92 (0.4)
'Missing'	530 (0.4)	0 (0.0)	44 (0.2)	110 (0.8)	116 (0.7)	123 (0.6)	137 (0.7)
External cause:							
Sexual abuse suspicion	9 (<0.1)	0 (0.0)	1 (<0.1)	1 (<0.1)	0 (0.0)	3 (<0.1)	4 (<0.1)
Sexual violence suspicion	6 (<0.1)	0 (0.0)	1 (<0.1)	1 (<0.1)	2 (<0.1)	1 (<0.1)	1 (<0.1)
Emotional violence suspicion	2616 (2.2)	4 (<0.1)	184 (0.7)	346 (2.4)	464 (2.7)	879 (4.2)	739 (3.6)
General illness	113626 (95.5)	20919 (98.5)	24604 (97.8)	13764 (95.7)	16042 (94.9)	19185 (92.5)	19112 (93.2)
Occupational illness	45 (<0.1)	5 (<0.1)	7 (<0.1)	2 (<0.1)	11 (0.1)	11 (0.1)	9 (<0.1)
Other diseases	2133 (1.8)	243 (1.1)	262 (1.0)	212 (1.5)	327 (1.9)	568 (2.7)	521 (2.5)
'Missing'	506 (0.4)	74 (0.3)	104 (0.4)	54 (0.4)	65 (0.4)	91 (0.4)	118 (0.6)
Status:							
Alive	118044 (99.2)	21143 (99.5)	25081 (99.7)	14246 (99.1)	16777 (99.2)	20535 (99.0)	20262 (98.8)
Death	897 (0.8)	102 (0.5)	82 (0.3)	134 (0.9)	134 (0.8)	203 (1.0)	242 (1.2)
Main diagnosis (ICD10 chapter):							
Certain Conditions Originating in the Perinatal Period	2363 (2.0)	228 (1.1)	336 (1.3)	373 (2.6)	433 (2.6)	438 (2.1)	555 (2.7)
Certain Infectious and Parasitic Diseases	6999 (5.9)	1039 (4.9)	1425 (5.7)	896 (6.2)	817 (4.8)	1410 (6.8)	1412 (6.9)
Congenital Malformation, Deformations, and Chromosomal Abnormalities	331 (0.3)	26 (0.1)	49 (0.2)	52 (0.4)	54 (0.3)	69 (0.3)	81 (0.4)
Diseases of the Blood and Blood Forming Organs and Certain Disorders Involving the Immune Mechanism	416 (0.3)	65 (0.3)	64 (0.3)	43 (0.3)	63 (0.4)	105 (0.5)	76 (0.4)
Diseases of the Circulatory System	2735 (2.3)	434 (2.0)	534 (2.1)	308 (2.1)	397 (2.3)	510 (2.5)	552 (2.7)
Diseases of the Digestive System	4744 (4.0)	932 (4.4)	1016 (4.0)	559 (3.9)	669 (4.0)	812 (3.9)	756 (3.7)
Diseases of the Ear and Mastoid Process	635 (0.5)	73 (0.3)	107 (0.4)	75 (0.5)	157 (0.9)	92 (0.4)	131 (0.6)
Diseases of the Eye and Adnexa	384 (0.3)	105 (0.5)	38 (0.2)	59 (0.4)	99 (0.6)	50 (0.2)	33 (0.2)
Diseases of the Genitourinary System	6836 (5.7)	866 (4.1)	1223 (4.9)	932 (6.5)	1245 (7.4)	1322 (6.4)	1248 (6.1)
Diseases of the Musculoskeletal System and Connective Tissue	2601 (2.2)	357 (1.7)	443 (1.8)	355 (2.5)	488 (2.9)	490 (2.4)	468 (2.3)
Diseases of the Nervous System	897 (0.8)	140 (0.7)	180 (0.7)	164 (1.1)	120 (0.7)	141 (0.7)	152 (0.7)

Feature	Total *N=118941*	2014 *N=21245*	2015 *N=25163*	2016 *N=14380*	2017 *N=16911*	2018 *N=20738*	2019 *N=20504*
Diseases of the Respiratory System	10952 (9.2)	1131 (5.3)	1788 (7.1)	1609 (11.2)	1744 (10.3)	2349 (11.3)	2331 (11.4)
Diseases of the Skin and Subcutaneous Tissue	3131 (2.6)	295 (1.4)	328 (1.3)	336 (2.3)	629 (3.7)	815 (3.9)	728 (3.6)
Endocrine, Nutritional, and Metabolic Disorders	2379 (2.0)	552 (2.6)	438 (1.7)	343 (2.4)	224 (1.3)	382 (1.8)	440 (2.1)
External Causes of Morbidity and Mortality	1075 (0.9)	160 (0.8)	216 (0.9)	145 (1.0)	184 (1.1)	179 (0.9)	191 (0.9)
Factors influencing Health Status and Contact with Health Services	3517 (3.0)	415 (2.0)	585 (2.3)	358 (2.5)	634 (3.7)	719 (3.5)	806 (3.9)
Injury, Poisoning, and Certain Other Consequences of External Causes	6038 (5.1)	946 (4.5)	1275 (5.1)	798 (5.5)	984 (5.8)	1067 (5.1)	968 (4.7)
Mental and Behavioral Disorders	861 (0.7)	45 (0.2)	92 (0.4)	67 (0.5)	138 (0.8)	227 (1.1)	292 (1.4)
Neoplasms	1542 (1.3)	178 (0.8)	200 (0.8)	200 (1.4)	298 (1.8)	379 (1.8)	287 (1.4)
Pregnancy, Childbirth, and the Puerperium	14346 (12.1)	1490 (7.0)	1998 (7.9)	1661 (11.6)	2551 (15.1)	3510 (16.9)	3136 (15.3)
Symptoms, Signs, and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified	45933 (38.6)	11692 (55.0)	12705 (50.5)	5020 (34.9)	4983 (29.5)	5672 (27.4)	5861 (28.6)
'Missing'	226 (0.2)	76 (0.4)	123 (0.5)	27 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)
Inconsistent diagnosis data:							
Q356	1 (<0.1)	0 (0.0)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Missing data in Hospitalizations Claims features, 2014-2019

Feature	Total *N=118941*	2014 *N=21245*	2015 *N=25163*	2016 *N=14380*	2017 *N=16911*	2018 *N=20738*	2019 *N=20504*	p-value*
Referral	530 (0.45)	0 (0.00)	44 (0.17)	110 (0.76)	116 (0.69)	123 (0.59)	137 (0.67)	<0.001
External cause	506 (0.43)	74 (0.35)	104 (0.41)	54 (0.38)	65 (0.38)	91 (0.44)	118 (0.58)	0.008
Status	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Main diagnosis	226 (0.19)	76 (0.36)	123 (0.49)	27 (0.19)	0 (0.00)	0 (0.00)	0 (0.00)	<0.001

*Chi-square test. Permutation Chi-square test is performed when the expected count in some cells is lower than 5.

Appendix 5 - Table. Consistency in Clinical procedures Claims by data set features, 2014-2019, n=6499526
Column percentages are computed unless otherwise specified

Feature	Total *N=6499526*	2014 *N=288214*	2015 *N=667100*	2016 *N=827080*	2017 *N=1317966*	2018 *N=1635732*	2019 *N=1763434*
Main diagnosis (ICD10 chapter):							
Certain Conditions Originating in the Perinatal Period	6014 (0.1)	283 (0.1)	518 (0.1)	731 (0.1)	1124 (0.1)	1441 (0.1)	1917 (0.1)
Certain Infectious and Parasitic Diseases	25258 (0.4)	827 (0.3)	2726 (0.4)	3301 (0.4)	4405 (0.3)	7611 (0.5)	6388 (0.4)
Congenital Malformation, Deformations, and Chromosomal Abnormalities	16256 (0.3)	228 (0.1)	1384 (0.2)	2071 (0.3)	2860 (0.2)	4448 (0.3)	5265 (0.3)
Diseases of the Blood and Blood Forming Organs and Certain Disorders Involving the Immune Mechanism	8651 (0.1)	352 (0.1)	948 (0.1)	1093 (0.1)	1300 (0.1)	2680 (0.2)	2278 (0.1)
Diseases of the Circulatory System	162206 (2.5)	2216 (0.8)	12990 (1.9)	18193 (2.2)	34708 (2.6)	43705 (2.7)	50394 (2.9)
Diseases of the Digestive System	551762 (8.5)	13408 (4.7)	57813 (8.7)	69866 (8.4)	151933 (11.5)	151250 (9.2)	107492 (6.1)
Diseases of the Ear and Mastoid Process	7251 (0.1)	235 (0.1)	589 (0.1)	1181 (0.1)	1167 (0.1)	2041 (0.1)	2038 (0.1)
Diseases of the Eye and Adnexa	12360 (0.2)	622 (0.2)	1524 (0.2)	1425 (0.2)	2013 (0.2)	2845 (0.2)	3931 (0.2)
Diseases of the Genitourinary System	108925 (1.7)	2484 (0.9)	8077 (1.2)	13245 (1.6)	22153 (1.7)	33313 (2.0)	29653 (1.7)
Diseases of the Musculoskeletal System and Connective Tissue	79436 (1.2)	2152 (0.7)	6269 (0.9)	8025 (1.0)	9679 (0.7)	26613 (1.6)	26698 (1.5)
Diseases of the Nervous System	45031 (0.7)	608 (0.2)	3500 (0.5)	6208 (0.8)	6987 (0.5)	12819 (0.8)	14909 (0.8)
Diseases of the Respiratory System	64421 (1.0)	1944 (0.7)	5562 (0.8)	9370 (1.1)	12592 (1.0)	18347 (1.1)	16606 (0.9)
Diseases of the Skin and Subcutaneous Tissue	16941 (0.3)	375 (0.1)	1686 (0.3)	2325 (0.3)	3363 (0.3)	4756 (0.3)	4436 (0.3)
Endocrine, Nutritional, and Metabolic Disorders	47397 (0.7)	771 (0.3)	4431 (0.7)	6364 (0.8)	9800 (0.7)	13679 (0.8)	12352 (0.7)
External Causes of Morbidity and Mortality	4494 (0.1)	115 (<0.1)	237 (<0.1)	420 (0.1)	1215 (0.1)	1350 (0.1)	1157 (0.1)
Factors influencing Health Status and Contact with Health Services	1439929 (22.2)	44654 (15.5)	140724 (21.1)	144950 (17.5)	230521 (17.5)	373012 (22.8)	506068 (28.7)
Injury, Poisoning, and Certain Other Consequences of External Causes	40757 (0.6)	1290 (0.4)	3930 (0.6)	4563 (0.6)	6945 (0.5)	12183 (0.7)	11846 (0.7)
Mental and Behavioral Disorders	67340 (1.0)	320 (0.1)	2186 (0.3)	5533 (0.7)	11007 (0.8)	22648 (1.4)	25646 (1.5)
Neoplasms	31013 (0.5)	815 (0.3)	1710 (0.3)	5114 (0.6)	5948 (0.5)	11052 (0.7)	6374 (0.4)
Pregnancy, Childbirth, and the Puerperium	21514 (0.3)	1482 (0.5)	1786 (0.3)	2490 (0.3)	4128 (0.3)	5503 (0.3)	6125 (0.3)
Symptoms, Signs, and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified	227575 (3.5)	10487 (3.6)	28236 (4.2)	31587 (3.8)	46110 (3.5)	57720 (3.5)	53435 (3.0)
'Missing'	3514995 (54.1)	202546 (70.3)	380274 (57.0)	489025 (59.1)	748008 (56.8)	826716 (50.5)	868426 (49.2)
Inconsistent diagnosis data:							
“H81 “	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
“NA “	179 (<0.1)	179 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
0000	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Feature	Total *N=6499526*	2014 *N=288214*	2015 *N=667100*	2016 *N=827080*	2017 *N=1317966*	2018 *N=1635732*	2019 *N=1763434*
A919	1 (<0.1)	1 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Procedure area of distribution:							
Outpatient	5441491 (83.7)	199467 (69.2)	560216 (84.0)	695109 (84.0)	1119369 (84.9)	1370276 (83.8)	1497054 (84.9)
Hospitalization	488735 (7.5)	43198 (15.0)	48755 (7.3)	56859 (6.9)	93364 (7.1)	119056 (7.3)	127503 (7.2)
Emergency	569300 (8.8)	45549 (15.8)	58129 (8.7)	75112 (9.1)	105233 (8.0)	146400 (9.0)	138877 (7.9)
Clinical procedure purpose:							
Diagnostic	2834281 (43.6)	148431 (51.5)	322766 (48.4)	380423 (46.0)	573980 (43.6)	731793 (44.7)	676888 (38.4)
Therapy	820844 (12.6)	26086 (9.1)	100011 (15.0)	114000 (13.8)	146402 (11.1)	201767 (12.3)	232578 (13.2)
Specific protection	2270865 (34.9)	99580 (34.6)	225672 (33.8)	308944 (37.4)	536411 (40.7)	587075 (35.9)	513183 (29.1)
Early detection of general illness	517175 (8.0)	14094 (4.9)	18618 (2.8)	21468 (2.6)	57293 (4.3)	104364 (6.4)	301338 (17.1)
Early detection of professional illness	56361 (0.9)	23 (<0.1)	33 (<0.1)	2245 (0.3)	3880 (0.3)	10733 (0.7)	39447 (2.2)
Procedure provider:							
Physician specialist	15354 (0.2)	7935 (2.8)	916 (0.1)	893 (0.1)	1566 (0.1)	2032 (0.1)	2012 (0.1)
Physician generalist	16003 (0.2)	9524 (3.3)	830 (0.1)	1113 (0.1)	1440 (0.1)	1506 (0.1)	1590 (0.1)
Nurse	154 (<0.1)	87 (<0.1)	3 (<0.1)	33 (<0.1)	1 (<0.1)	20 (<0.1)	10 (<0.1)
Ancillary nurse	93 (<0.1)	6 (<0.1)	1 (<0.1)	0 (0.0)	4 (<0.1)	45 (<0.1)	37 (<0.1)
Other	11961 (0.2)	11931 (4.1)	6 (<0.1)	12 (<0.1)	6 (<0.1)	4 (<0.1)	2 (<0.1)
'Missing'	6455961 (99.3)	258731 (89.8)	665344 (99.7)	825029 (99.8)	1314949 (99.8)	1632125 (99.8)	1759783 (99.8)
Surgical intervention type:							
Unique	713916 (11.0)	16570 (5.7)	63072 (9.5)	78177 (9.5)	143791 (10.9)	189201 (11.6)	223105 (12.7)
Multiple, same way, different medical specialty	35991 (0.6)	2707 (0.9)	1477 (0.2)	373 (<0.1)	11988 (0.9)	9580 (0.6)	9866 (0.6)
Multiple, same way, same medical specialty	42996 (0.7)	464 (0.2)	1013 (0.2)	5264 (0.6)	13469 (1.0)	11403 (0.7)	11383 (0.6)
Multiple, different way, different medical specialty	93 (<0.1)	0 (0.0)	14 (<0.1)	7 (<0.1)	24 (<0.1)	36 (<0.1)	12 (<0.1)
Multiple, different way, same medical specialty	3560 (0.1)	95 (<0.1)	294 (<0.1)	388 (<0.1)	789 (0.1)	996 (0.1)	998 (0.1)
'Missing'	5702970 (87.7)	268378 (93.1)	601230 (90.1)	742871 (89.8)	1147905 (87.1)	1424516 (87.1)	1518070 (86.1)
Total procedure cost [Median of COP (Q1; Q3)]	3000.0 [0.0;16200.0]	12324.0 [8200.0;22776.0]	12463.0 [3900.0;17845.0]	0.0 [0.0;14200.0]	12818.2 [9842.2;37082.2]	0.0 [0.0;6342.0]	0.0 [0.0;7700.0]

Missing data in Clinical procedures Claims by data set features, 2014-2019

Feature	Total	2014	2015	2016	2017	2018	2019	p-value*
	N=6499526	*N=288214*	*N=667100*	*N=827080*	*N=1317966*	*N=1635732*	*N=1763434*	
Main diagnosis	3514995 (54.1)	202546 (70.3)	380274 (57.0)	489025 (59.1)	748008 (56.8)	826716 (50.5)	868426 (49.2)	0.000
Area of distribution	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Clinical procedure purpose	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.
Total procedure cost	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	.

*Permutation Chi-square test is performed when the expected count in some cells is lower than 5.

Appendix 6 - Table. Consistency in Patient identification information dataset, 2014-2019, n=226548

Column percentages are computed unless otherwise specified

Feature	Total *N=226548*
User type: Subsidized	226548 (100)
Patient age	23.0 [11.0;41.0]
Age type: Years	226548 (100)
Sex:	
Female	121961 (53.8)
Male	104587 (46.2)
Department of residence: La Guajira	226548 (100)
Municipality of residence:	
Riohacha	27502 (12.1)
Albania	11998 (5.3)
Barrancas	4964 (2.2)
Distracción	2305 (1.0)
El Molino	250 (0.1)
Maicao	83013 (36.6)
Manaure	23199 (10.2)
Uribia	66648 (29.4)
Villanueva	2650 (1.2)
San Juan del Cesar	4019 (1.8)
Area of residence:	
Urban	80272 (35.4)
Rural	146276 (64.6)

Appendix 7 - Table. Consistency in Patient enrollment information dataset, n=305126

Feature	Total *N=305126*
Patient age [Median (Q1; Q3)]	26.0 [13.0;43.0]
Sex:	
Female	158767 (52.0)
Male	146359 (48.0)
Indigenous:	
Yes	210381 (68.9)
No	94745 (31.1)

Feature	Total *N=305126*
User type:	
Contributor	3925 (1.3)
Subsidized	202397 (66.3)
'Missing'	98804 (32.4)
Status:	
Retired	91568 (30.0)
Active	208183 (68.2)
Death	5375 (1.8)
Municipality of residence:	
Maicao	116762 (38.3)
Uribia	79785 (26.1)
Riohacha	39071 (12.8)
Manaure	34789 (11.4)
Albania	16129 (5.3)
Barrancas	6510 (2.1)
San Juan	5584 (1.8)
Villanueva	3218 (1.1)
Distracción	2407 (0.8)
El Molino	871 (0.3)
Area of residence:	
Urban	110826 (36.3)
Rural	167952 (55.0)
Dispersed rural settlement	26348 (8.6)
Year of enrollment:	
2001	3195 (1.0)
2002	2298 (0.8)
2003	17477 (5.7)
2004	23895 (7.8)
2005	23510 (7.7)
2006	21993 (7.2)
2007	10882 (3.6)
2008	8935 (2.9)
2009	14555 (4.8)
2010	9419 (3.1)
2011	5354 (1.8)
2012	10702 (3.5)

Feature	Total *N=305126*
2013	13471 (4.4)
2014	11495 (3.8)
2015	10982 (3.6)
2016	9069 (3.0)
2017	60050 (19.7)
2018	17873 (5.9)
2019	18419 (6.0)
2020	11466 (3.8)
'Missing'	86 (<0.1)
Year of status change:	
2001	1 (<0.1)
2002	102 (<0.1)
2003	3608 (1.2)
2004	3085 (1.0)
2005	2879 (0.9)
2006	18819 (6.2)
2007	4311 (1.4)
2008	5567 (1.8)
2009	12460 (4.1)
2010	8494 (2.8)
2011	16845 (5.5)
2012	13467 (4.4)
2013	15142 (5.0)
2014	19368 (6.3)
2015	17734 (5.8)
2016	15206 (5.0)
2017	60627 (19.9)
2018	31513 (10.3)
2019	21324 (7.0)
2020	34508 (11.3)
'Missing'	66 (<0.1)

Appendix 8 - Table. Duplicity in administrative health data by healthcare service and year of delivery, 2014-2019, data: AHR

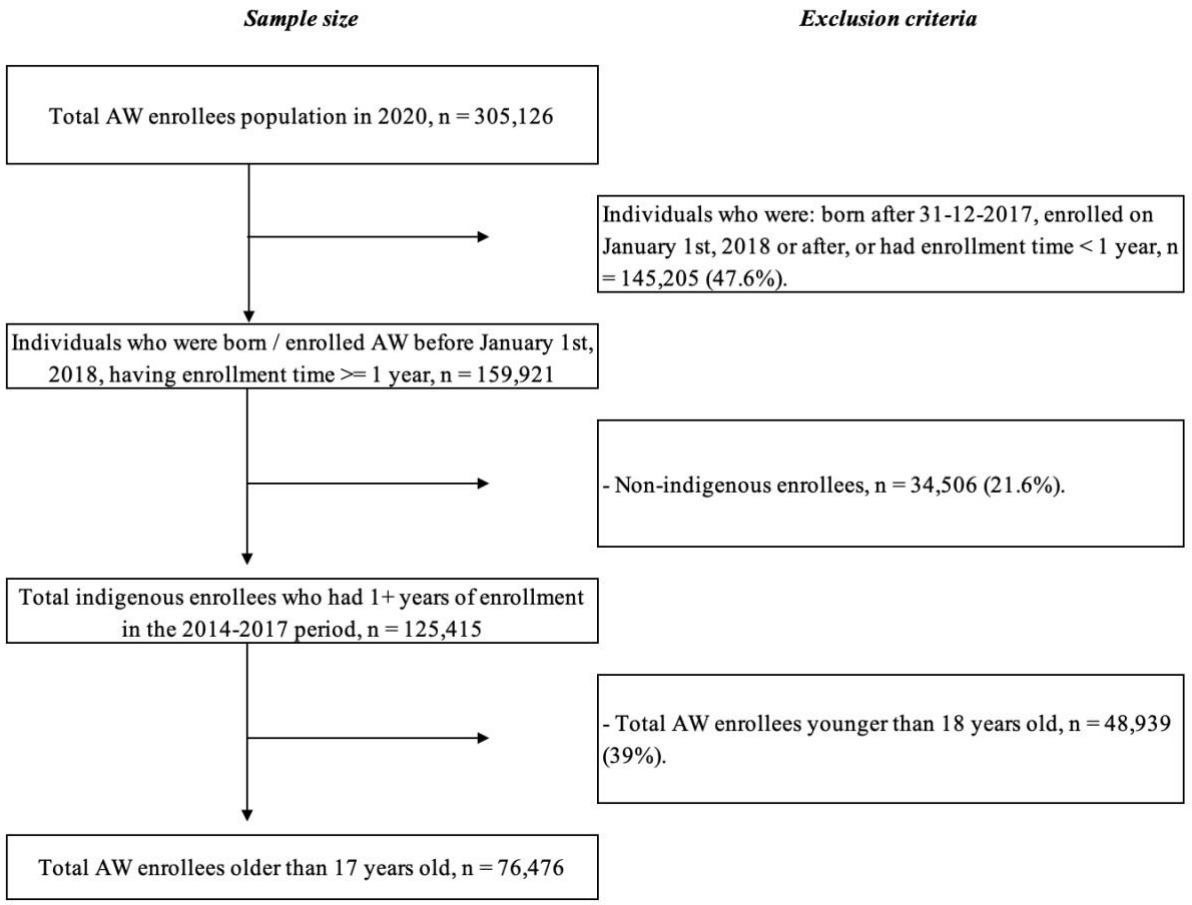
Year	Physician visits		Clinical Procedures		Hospitalizations		Emergency visits	
	Claims [n]	Duplicate records [n(%)]	Claims [n]	Duplicate records [n(%)]	Claims [n]	Duplicate records [n(%)]	Claims [n]	Duplicate records [n(%)]
2014	134,505	4,999 (3.72)	288,214	17,018 (5.9)	21,245	218 (1.03)	24,008	237 (0.99)
2015	419,479	18,633 (4.44)	667,100	38,210 (5.73)	25,163	264 (1.05)	29,714	249 (0.84)
2016	590,410	34,122 (5.78)	827,080	52,294 (6.32)	14,380	220 (1.53)	32,469	379 (1.17)
2017	700,184	8,997 (1.28)	1,317,966	61,029 (4.63)	16,911	100 (0.59)	47,102	340 (0.72)
2018	840,395	8,788 (1.05)	1,635,732	73,037 (4.47)	20,738	425 (2.05)	57,477	569 (0.99)
2019	870,109	12,144 (1.4)	1,763,434	114,587 (6.5)	20,504	1,348 (6.57)	58,862	1,963 (3.33)

Consistency in enrollees' user type data by comparing Enrollment and AHR data sets data

Consistent data in italic font

Enrollment data collected by AW	Patient personal information data collected by healthcare service providers	n records	% Column
Contributor	Subsidized	3,671	1.20
Contributor	Missing	254	0.08
Subsidized	***Subsidized***	*174,620*	*57.23*
Subsidized	Missing	27,777	9.10
Missing	Subsidized	48,254	15.81
Missing	*Missing*	*50,550*	*16.57*

Appendix 9. Study population



Appendix 10 - Table. Healthcare services utilization to Indigenous enrollees by sex and age group, 2014-2017, data: AHR, n=125415

	Female n (% column)						Male n (% column)					
	Total	**<18**	**18-24**	**25-44**	**45-65**	**65+**	**Total**	**<18**	**18-24**	**25-44**	**45-65**	**65+**
	N=64947	*N=24064*	*N=10496*	*N=17260*	*N=7854*	*N=5273*	***N=60468***	*N=24875*	*N=10194*	*N=14613*	*N=6704*	*N=4082*
Number of Physician visits claims:												
0	20827 (32.1)	5444 (22.6)	4159 (39.6)	6219 (36.0)	2793 (35.6)	2212 (41.9)	24810 (41.0)	5993 (24.1)	5657 (55.5)	8156 (55.8)	3058 (45.6)	1946 (47.7)
1	2963 (4.6)	1177 (4.9)	415 (4.0)	611 (3.5)	412 (5.2)	348 (6.6)	3832 (6.3)	1335 (5.4)	676 (6.6)	1066 (7.3)	504 (7.5)	251 (6.1)
2	2578 (4.0)	1070 (4.4)	318 (3.0)	521 (3.0)	339 (4.3)	330 (6.3)	2868 (4.7)	1122 (4.5)	456 (4.5)	674 (4.6)	353 (5.3)	263 (6.4)
3	2343 (3.6)	964 (4.0)	285 (2.7)	484 (2.8)	318 (4.0)	292 (5.5)	2278 (3.8)	1016 (4.1)	331 (3.2)	456 (3.1)	256 (3.8)	219 (5.4)
4	2232 (3.4)	1016 (4.2)	240 (2.3)	428 (2.5)	260 (3.3)	288 (5.5)	2094 (3.5)	989 (4.0)	312 (3.1)	361 (2.5)	240 (3.6)	192 (4.7)
5	1938 (3.0)	842 (3.5)	226 (2.2)	373 (2.2)	241 (3.1)	256 (4.9)	1770 (2.9)	877 (3.5)	223 (2.2)	274 (1.9)	217 (3.2)	179 (4.4)
6	1733 (2.7)	793 (3.3)	205 (2.0)	343 (2.0)	200 (2.5)	192 (3.6)	1522 (2.5)	825 (3.3)	140 (1.4)	252 (1.7)	173 (2.6)	132 (3.2)
7	1564 (2.4)	723 (3.0)	201 (1.9)	309 (1.8)	171 (2.2)	160 (3.0)	1307 (2.2)	736 (3.0)	135 (1.3)	192 (1.3)	132 (2.0)	112 (2.7)
8	1602 (2.5)	786 (3.3)	178 (1.7)	310 (1.8)	189 (2.4)	139 (2.6)	1229 (2.0)	734 (3.0)	106 (1.0)	168 (1.1)	125 (1.9)	96 (2.4)
9+	27167 (41.8)	11249 (46.7)	4269 (40.7)	7662 (44.4)	2931 (37.3)	1056 (20.0)	18758 (31.0)	11248 (45.2)	2158 (21.2)	3014 (20.6)	1646 (24.6)	692 (17.0)
Number of Hospitalization claims:												
0	51567 (79.4)	20239 (84.1)	7879 (75.1)	12563 (72.8)	6455 (82.2)	4431 (84.0)	53279 (88.1)	20879 (83.9)	9496 (93.2)	13431 (91.9)	6007 (89.6)	3466 (84.9)
1	7466 (11.5)	2310 (9.6)	1477 (14.1)	2539 (14.7)	733 (9.3)	407 (7.7)	4243 (7.0)	2328 (9.4)	477 (4.7)	753 (5.2)	389 (5.8)	296 (7.3)
2	2986 (4.6)	791 (3.3)	579 (5.5)	1105 (6.4)	289 (3.7)	222 (4.2)	1499 (2.5)	831 (3.3)	137 (1.3)	240 (1.6)	148 (2.2)	143 (3.5)
3	1266 (1.9)	329 (1.4)	226 (2.2)	472 (2.7)	156 (2.0)	83 (1.6)	623 (1.0)	384 (1.5)	43 (0.4)	80 (0.5)	58 (0.9)	58 (1.4)
4	673 (1.0)	164 (0.7)	143 (1.4)	227 (1.3)	94 (1.2)	45 (0.9)	311 (0.5)	170 (0.7)	17 (0.2)	42 (0.3)	43 (0.6)	39 (1.0)
5	372 (0.6)	79 (0.3)	88 (0.8)	132 (0.8)	43 (0.5)	30 (0.6)	195 (0.3)	102 (0.4)	16 (0.2)	28 (0.2)	23 (0.3)	26 (0.6)
6	195 (0.3)	52 (0.2)	25 (0.2)	72 (0.4)	26 (0.3)	20 (0.4)	106 (0.2)	65 (0.3)	6 (0.1)	11 (0.1)	13 (0.2)	11 (0.3)
7	132 (0.2)	29 (0.1)	29 (0.3)	48 (0.3)	17 (0.2)	9 (0.2)	60 (0.1)	33 (0.1)	1 (<0.1)	9 (0.1)	7 (0.1)	10 (0.2)
8	90 (0.1)	19 (0.1)	19 (0.2)	32 (0.2)	14 (0.2)	6 (0.1)	54 (0.1)	31 (0.1)	1 (<0.1)	3 (<0.1)	8 (0.1)	11 (0.3)
9+	200 (0.3)	52 (0.2)	31 (0.3)	70 (0.4)	27 (0.3)	20 (0.4)	98 (0.2)	52 (0.2)	0 (0.0)	16 (0.1)	8 (0.1)	22 (0.5)
Number of Emergency visits claims:												
0	47426 (73.0)	18553 (77.1)	7345 (70.0)	11551 (66.9)	5845 (74.4)	4132 (78.4)	49823 (82.4)	19201 (77.2)	8997 (88.3)	12614 (86.3)	5698 (85.0)	3313 (81.2)
1	8053 (12.4)	2792 (11.6)	1325 (12.6)	2458 (14.2)	955 (12.2)	523 (9.9)	5556 (9.2)	2777 (11.2)	699 (6.9)	1177 (8.1)	553 (8.2)	350 (8.6)
2	3852 (5.9)	1182 (4.9)	680 (6.5)	1330 (7.7)	422 (5.4)	238 (4.5)	2256 (3.7)	1212 (4.9)	280 (2.7)	404 (2.8)	194 (2.9)	166 (4.1)
3	2095 (3.2)	595 (2.5)	447 (4.3)	698 (4.0)	229 (2.9)	126 (2.4)	1126 (1.9)	646 (2.6)	106 (1.0)	180 (1.2)	109 (1.6)	85 (2.1)
4	1157 (1.8)	333 (1.4)	216 (2.1)	411 (2.4)	126 (1.6)	71 (1.3)	593 (1.0)	352 (1.4)	48 (0.5)	100 (0.7)	51 (0.8)	42 (1.0)
5	714 (1.1)	202 (0.8)	139 (1.3)	234 (1.4)	85 (1.1)	54 (1.0)	373 (0.6)	231 (0.9)	26 (0.3)	36 (0.2)	35 (0.5)	45 (1.1)
6	494 (0.8)	122 (0.5)	101 (1.0)	166 (1.0)	64 (0.8)	41 (0.8)	220 (0.4)	131 (0.5)	13 (0.1)	36 (0.2)	21 (0.3)	19 (0.5)
7	314 (0.5)	85 (0.4)	70 (0.7)	99 (0.6)	33 (0.4)	27 (0.5)	142 (0.2)	93 (0.4)	10 (0.1)	16 (0.1)	13 (0.2)	10 (0.2)
8	249 (0.4)	63 (0.3)	58 (0.6)	97 (0.6)	13 (0.2)	18 (0.3)	114 (0.2)	72 (0.3)	4 (<0.1)	13 (0.1)	12 (0.2)	13 (0.3)
9+	593 (0.9)	137 (0.6)	115 (1.1)	216 (1.3)	82 (1.0)	43 (0.8)	265 (0.4)	160 (0.6)	11 (0.1)	37 (0.3)	18 (0.3)	39 (1.0)
Number of Clinical procedures claims:												
0	22675 (34.9)	6294 (26.2)	4345 (41.4)	6420 (37.2)	3118 (39.7)	2498 (47.4)	27655 (45.7)	6978 (28.1)	6067 (59.5)	8916 (61.0)	3520 (52.5)	2174 (53.3)

	Female n (% column)						Male n (% column)					
	Total	**<18**	**18-24**	**25-44**	**45-65**	**65+**	**Total**	**<18**	**18-24**	**25-44**	**45-65**	**65+**
	N=64947	*N=24064*	*N=10496*	*N=17260*	*N=7854*	*N=5273*	***N=60468***	*N=24875*	*N=10194*	*N=14613*	*N=6704*	*N=4082*
1	1379 (2.1)	548 (2.3)	175 (1.7)	300 (1.7)	162 (2.1)	194 (3.7)	1586 (2.6)	524 (2.1)	251 (2.5)	466 (3.2)	191 (2.8)	154 (3.8)
2	1568 (2.4)	628 (2.6)	176 (1.7)	341 (2.0)	236 (3.0)	187 (3.5)	1665 (2.8)	689 (2.8)	239 (2.3)	424 (2.9)	195 (2.9)	118 (2.9)
3	1847 (2.8)	966 (4.0)	172 (1.6)	348 (2.0)	205 (2.6)	156 (3.0)	1912 (3.2)	937 (3.8)	294 (2.9)	403 (2.8)	194 (2.9)	84 (2.1)
4	1656 (2.5)	895 (3.7)	221 (2.1)	280 (1.6)	163 (2.1)	97 (1.8)	1620 (2.7)	896 (3.6)	262 (2.6)	277 (1.9)	125 (1.9)	60 (1.5)
5	1322 (2.0)	673 (2.8)	145 (1.4)	273 (1.6)	142 (1.8)	89 (1.7)	1216 (2.0)	679 (2.7)	157 (1.5)	215 (1.5)	97 (1.4)	68 (1.7)
6	1380 (2.1)	767 (3.2)	126 (1.2)	239 (1.4)	151 (1.9)	97 (1.8)	1325 (2.2)	776 (3.1)	142 (1.4)	226 (1.5)	95 (1.4)	86 (2.1)
7	1236 (1.9)	643 (2.7)	136 (1.3)	237 (1.4)	121 (1.5)	99 (1.9)	1102 (1.8)	648 (2.6)	122 (1.2)	161 (1.1)	102 (1.5)	69 (1.7)
8	1261 (1.9)	675 (2.8)	136 (1.3)	223 (1.3)	118 (1.5)	109 (2.1)	1191 (2.0)	714 (2.9)	140 (1.4)	147 (1.0)	95 (1.4)	95 (2.3)
9+	30623 (47.2)	11975 (49.8)	4864 (46.3)	8599 (49.8)	3438 (43.8)	1747 (33.1)	21196 (35.1)	12034 (48.4)	2520 (24.7)	3378 (23.1)	2090 (31.2)	1174 (28.8)

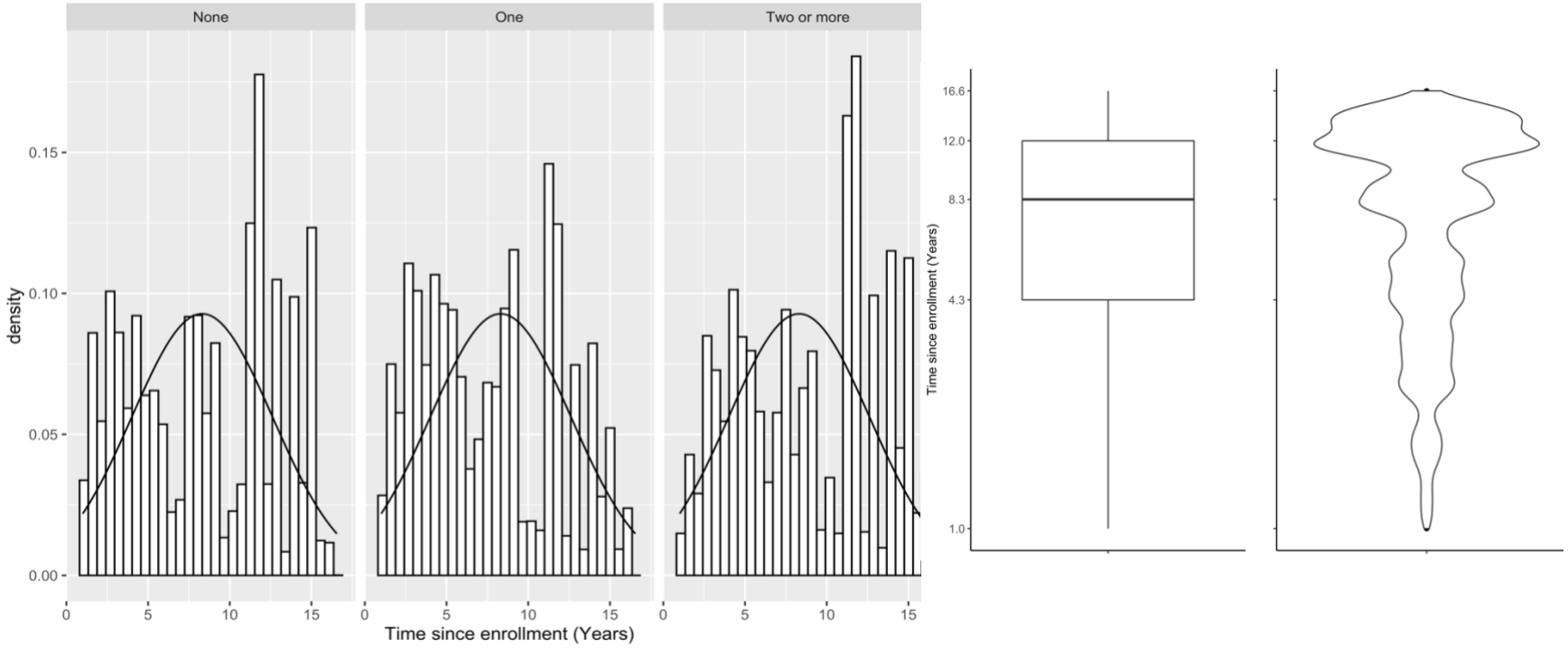
Appendix 11 - Table. Distribution of Indigenous enrollees according to number of chronic conditions, 2014-2017, n=125415

Column percentages are computed unless otherwise specified

Variable	**Total**	**None**	**One**	**Two or more**	**p-value***
	N=125415	*N=96136*	*N=19008*	*N=10271*	
Sex:					<0.001
Female	64947 (51.8)	47091 (49.0)	10765 (56.6)	7091 (69.0)	
Male	60468 (48.2)	49045 (51.0)	8243 (43.4)	3180 (31.0)	
Age:					<0.001
<18	48939 (39.0)	39610 (41.2)	7834 (41.2)	1495 (14.6)	
18-24	20690 (16.5)	17053 (17.7)	2491 (13.1)	1146 (11.2)	
25-44	31873 (25.4)	23962 (24.9)	4748 (25.0)	3163 (30.8)	
45-65	14558 (11.6)	9474 (9.9)	2442 (12.8)	2642 (25.7)	
65+	9355 (7.5)	6037 (6.3)	1493 (7.9)	1825 (17.8)	
Household size [Median (Q1; Q3)]	3.0 [2.0;6.0]	3.0 [2.0;6.0]	3.0 [2.0;4.0]	3.0 [2.0;8.0]	<0.001
User type:					-
Contributor	1239 (1.0)	736 (0.8)	310 (1.6)	193 (1.9)	
Subsidized	108938 (86.9)	80168 (83.4)	18692 (98.3)	10078 (98.1)	
'Missing'	15238 (12.2)	15232 (15.8)	6 (<0.1)	0 (0.0)	
Time since enrollment [Median of years (Q1; Q3)]	8.3 [4.3;12.0]	8.4 [4.3;12.0]	7.8 [4.1;11.3]	9.1 [5.0;12.0]	-
Enrollment period:					<0.001
<2010	67500 (53.8)	52664 (54.8)	9035 (47.5)	5801 (56.5)	

Variable	Total	None	One	Two or more	p-value*
	N=125415	*N=96136*	*N=19008*	*N=10271*	
2010-2013	30126 (24.0)	21862 (22.7)	5435 (28.6)	2829 (27.5)	
2014-2017	27789 (22.2)	21610 (22.5)	4538 (23.9)	1641 (16.0)	
Region of residence:					<0.001
Lower	9174 (7.3)	7564 (7.9)	1093 (5.8)	517 (5.0)	
Middle	69440 (55.4)	52152 (54.2)	10522 (55.4)	6766 (65.9)	
Upper	46801 (37.3)	36420 (37.9)	7393 (38.9)	2988 (29.1)	
Municipality of residence:					-
Maicao	42556 (33.9)	32043 (33.3)	6505 (34.2)	4008 (39.0)	
Uribia	46801 (37.3)	36420 (37.9)	7393 (38.9)	2988 (29.1)	
Riohacha	9456 (7.5)	7438 (7.7)	1278 (6.7)	740 (7.2)	
Manaure	17428 (13.9)	12671 (13.2)	2739 (14.4)	2018 (19.6)	
Albania	7261 (5.8)	6171 (6.4)	785 (4.1)	305 (3.0)	
Barrancas	1015 (0.8)	745 (0.8)	167 (0.9)	103 (1.0)	
San Juan	271 (0.2)	187 (0.2)	47 (0.2)	37 (0.4)	
Villanueva	69 (0.1)	50 (0.1)	10 (0.1)	9 (0.1)	
Distracción	558 (0.4)	411 (0.4)	84 (0.4)	63 (0.6)	
Area of residence:					<0.001
Urban	17834 (14.2)	13096 (13.6)	2622 (13.8)	2116 (20.6)	
Rural	107581 (85.8)	83040 (86.4)	16386 (86.2)	8155 (79.4)	
Status:					<0.001
Dead	1992 (1.6)	1108 (1.2)	411 (2.2)	473 (4.6)	
Alive	123423 (98.4)	95028 (98.8)	18597 (97.8)	9798 (95.4)	

*Exact Fisher test; Permutation Chi-square test is performed when the expected count in some cells is lower than 5.



Appendix 12 - Figure 2. Time since enrollment (by 31 December 2017) and number of chronic conditions observed in Indigenous enrollees, 2014-2017, data: AHR, n=125415

Kruskal-Wallis's rank sum testing statistically significant differences in the Median of years among the three patient groups: Kruskal-Wallis's chi-squared = 592.99, df = 2, p-value < 0.001

Appendix 13 - Table. Characteristics of Indigenous enrollees older than 17 years old by sex, 2014-2017, n=76476

Column percentages are computed unless otherwise specified

Variable	Total *N=76476*	Male *N=35593*	Female *N=40883*	p-value*
Age:				<0.001
18-24	20690 (27.1)	10194 (28.6)	10496 (25.7)	
25-44	31873 (41.7)	14613 (41.1)	17260 (42.2)	
45-65	14558 (19.0)	6704 (18.8)	7854 (19.2)	
65+	9355 (12.2)	4082 (11.5)	5273 (12.9)	
Household size [Median (Q1; Q3)]	6.0 [3.0;15.0]	6.0 [3.0;14.0]	6.0 [3.0;16.0]	-
User type:				<0.001
Contributor	1004 (1.6)	517 (1.8)	487 (1.4)	
Subsidized	62683 (98.4)	28378 (98.2)	34305 (98.6)	
Time since enrollment [Median of years (Q1; Q3)]	11.3 [6.3;13.1]	11.3 [6.0;13.1]	11.3 [6.5;13.1]	-
Enrollment period:				0.067
<2010	51948 (67.9)	24028 (67.5)	27920 (68.3)	
2010-2013	14276 (18.7)	6724 (18.9)	7552 (18.5)	
2014-2017	10252 (13.4)	4841 (13.6)	5411 (13.2)	
Region of residence:				<0.001
Upper	28202 (36.9)	13421 (37.7)	14781 (36.2)	
Lower	5296 (6.9)	2511 (7.1)	2785 (6.8)	
Middle	42978 (56.2)	19661 (55.2)	23317 (57.0)	
Area of residence:				0.083
Rural	64566 (84.4)	30137 (84.7)	34429 (84.2)	
Urban	11910 (15.6)	5456 (15.3)	6454 (15.8)	
Status:				0.014
Alive	74848 (97.9)	34786 (97.7)	40062 (98.0)	
Dead	1628 (2.1)	807 (2.3)	821 (2.0)	

*Exact Fisher test; Permutation Chi-square test is performed when the expected count in some cells is lower than five.

Appendix 14 - Table. Prevalence of chronic conditions in Indigenous enrollees aged 18+ years, 2014-2017, data=AHR, n=76476

Chronic condition [n (prevalence)]	**Female** (n=40883)	**Male** (n=35593)	**Total**
Chronic low back pain	3253 (7.96)	2038 (5.73)	5291 (6.92)
Chronic pain	3134 (7.67)	1777 (4.99)	4911 (6.42)
Genitourinary diseases	2359 (5.77)	777 (2.18)	3136 (4.1)
Dizziness	2233 (5.46)	669 (1.88)	2902 (3.79)
Hypertension	1359 (3.32)	763 (2.14)	2122 (2.77)
Gastritis	1042 (2.55)	810 (2.28)	1852 (2.42)
Chronic periodontitis and gingivitis	1286 (3.15)	545 (1.53)	1831 (2.39)
Anemia	1437 (3.51)	198 (0.56)	1635 (2.14)
Migraine/chronic headache	1361 (3.33)	277 (0.78)	1638 (2.14)
Disorders of the lipoprotein metabolism	948 (2.32)	431 (1.21)	1379 (1.8)
Allergy	863 (2.11)	343 (0.96)	1206 (1.58)
Severe constipation	576 (1.41)	468 (1.31)	1044 (1.37)
Diabetes	622 (1.52)	339 (0.95)	961 (1.26)
Severe vision reduction	481 (1.18)	361 (1.01)	842 (1.1)
Depression	644 (1.58)	16 (0.04)	660 (0.86)
Chronic cholecystitis/gallstones	413 (1.01)	85 (0.24)	498 (0.65)
Joint arthrosis	327 (0.8)	126 (0.35)	453 (0.59)
Cancer	342 (0.84)	104 (0.29)	446 (0.58)
COPD/asthma	300 (0.73)	140 (0.39)	440 (0.58)
Arthritis	247 (0.6)	88 (0.25)	335 (0.44)
Obesity	264 (0.65)	52 (0.15)	316 (0.41)
Cardiac disease	150 (0.37)	117 (0.33)	267 (0.35)
Neuropathy	171 (0.42)	65 (0.18)	236 (0.31)
Hemorrhoids	87 (0.21)	70 (0.2)	157 (0.21)
Thyroid dysfunction	138 (0.34)	18 (0.05)	156 (0.2)
Human Immunodeficiency Virus	107 (0.26)	41 (0.12)	148 (0.19)
Tuberculosis	82 (0.2)	54 (0.15)	136 (0.18)
Chronic kidney disease	46 (0.11)	72 (0.2)	118 (0.15)
Epilepsy	63 (0.15)	50 (0.14)	113 (0.15)
Malnutrition and cachexia	80 (0.2)	25 (0.07)	105 (0.14)
Anxiety	60 (0.15)	32 (0.09)	92 (0.12)
Brain infarction/hemorrhage	54 (0.13)	39 (0.11)	93 (0.12)
Severe hearing loss	48 (0.12)	35 (0.1)	83 (0.11)
Chronic sinusitis	41 (0.1)	18 (0.05)	59 (0.08)

Chronic condition [n (prevalence)]	**Female** (n=40883)	**Male** (n=35593)	**Total**
Mental and behavioral disorders	28 (0.07)	22 (0.06)	50 (0.07)
Sleep disorder	22 (0.05)	22 (0.06)	44 (0.06)
Liver-, gallbladder- and pancreas disease	28 (0.07)	11 (0.03)	39 (0.05)
Osteoporosis/osteoarthrosis	27 (0.07)	10 (0.03)	37 (0.05)
Hypotension	20 (0.05)	7 (0.02)	27 (0.04)
Psoriasis	8 (0.02)	21 (0.06)	29 (0.04)
Ulcer of the skin	18 (0.04)	13 (0.04)	31 (0.04)
Colitis ulcerous/Chron´s disease	14 (0.03)	8 (0.02)	22 (0.03)
Sexual dysfunction	9 (0.02)	16 (0.04)	25 (0.03)
Dementia	10 (0.02)	7 (0.02)	17 (0.02)
Parkinson disease	8 (0.02)	10 (0.03)	18 (0.02)
Mental disorders due to alcohol	3 (0.01)	7 (0.02)	10 (0.01)
Parathyroidism	2 (0)	2 (0.01)	4 (0.01)
Multiple sclerosis	4 (0.01)	1 (0)	5 (0.01)
Delirium	-	2 (0.01)	2 (0)
Mental disorders due to tobacco	-	1 (0)	1 (0)

Appendix 15 - Table. Prevalence of chronic conditions in AW Indigenous enrollees aged <18 years old, 2014-2017, data=AHR, n=48939

Chronic condition [n (prevalence)]	Female	Male	Total
Malnutrition and cachexia	2151 (8.94)	2058 (8.27)	4209 (8.6)
Allergy	702 (2.92)	628 (2.52)	1330 (2.72)
Anemia	535 (2.22)	471 (1.89)	1006 (2.06)
Chronic periodontitis and gingivitis	378 (1.57)	336 (1.35)	714 (1.46)
COPD/asthma	264 (1.1)	314 (1.26)	578 (1.18)
Chronic pain	256 (1.06)	251 (1.01)	507 (1.04)
Severe constipation	214 (0.89)	222 (0.89)	436 (0.89)
Chronic low back pain	213 (0.89)	204 (0.82)	417 (0.85)
Dizziness	225 (0.94)	152 (0.61)	377 (0.77)
Obesity	151 (0.63)	187 (0.75)	338 (0.69)
Migraine/chronic headache	126 (0.52)	59 (0.24)	185 (0.38)
Genitourinary diseases	93 (0.39)	58 (0.23)	151 (0.31)
Severe vision reduction	73 (0.3)	63 (0.25)	136 (0.28)
Cancer	53 (0.22)	42 (0.17)	95 (0.19)
Gastritis	40 (0.17)	45 (0.18)	85 (0.17)
Cardiac disease	39 (0.16)	27 (0.11)	66 (0.13)
Epilepsy	27 (0.11)	36 (0.14)	63 (0.13)
Arthritis	30 (0.12)	29 (0.12)	59 (0.12)
Depression	42 (0.17)	6 (0.02)	48 (0.1)
Disorders of the lipoprotein metabolism	23 (0.1)	20 (0.08)	43 (0.09)
Severe hearing loss	21 (0.09)	23 (0.09)	44 (0.09)
Thyroid dysfunction	28 (0.12)	12 (0.05)	40 (0.08)
Diabetes	17 (0.07)	18 (0.07)	35 (0.07)
Neuropathy	10 (0.04)	11 (0.04)	21 (0.04)
Anxiety	7 (0.03)	6 (0.02)	13 (0.03)
Chronic cholecystitis/gallstones	8 (0.03)	5 (0.02)	13 (0.03)
Mental and behavioral disorders	8 (0.03)	6 (0.02)	14 (0.03)
Tuberculosis	8 (0.03)	6 (0.02)	14 (0.03)
Brain infarction/hemorrhage	5 (0.02)	5 (0.02)	10 (0.02)
Colitis ulcerous/Chron´s disease	3 (0.01)	6 (0.02)	9 (0.02)
Osteoporosis/osteoarthrosis	4 (0.02)	-	4 (0.02)
Psoriasis	5 (0.02)	4 (0.02)	9 (0.02)

Chronic condition [n (prevalence)]	Female	Male	Total
Chronic sinusitis	4 (0.02)	4 (0.02)	8 (0.02)
Sleep disorder	5 (0.02)	7 (0.03)	12 (0.02)
Chronic kidney disease	2 (0.01)	2 (0.01)	4 (0.01)
Hemorrhoids	1 (0)	4 (0.02)	5 (0.01)
Human Immunodeficiency Virus	1 (0)	6 (0.02)	7 (0.01)
Hypertension	3 (0.01)	3 (0.01)	6 (0.01)
Joint arthrosis	2 (0.01)	1 (0)	3 (0.01)
Ulcer of the skin	4 (0.02)	2 (0.01)	6 (0.01)
Vitamin-D deficiency	1 (0)	-	1 (0)
Hypotension	1 (0)	-	1 (0)
Parathyroidism	1 (0)	-	1 (0)
Multiple sclerosis	1 (0)	-	1 (0)
Dementia	-	1 (0)	1 (0)
Delirium	-	1 (0)	1 (0)

Appendix 16 - Table. Prevalence of chronic conditions in AW Indigenous enrollees aged 18-44 years old, 2014-2017, data=AHR, n=52563

Chronic condition [n (prevalence)]	Female	Male	Total
Chronic low back pain	1860 (6.7)	1071 (4.32)	2931 (5.58)
Chronic pain	1436 (5.17)	847 (3.41)	2283 (4.34)
Genitourinary diseases	1542 (5.56)	309 (1.25)	1851 (3.52)
Dizziness	1361 (4.9)	290 (1.17)	1651 (3.14)
Chronic periodontitis and gingivitis	1004 (3.62)	378 (1.52)	1382 (2.63)
Migraine/chronic headache	975 (3.51)	177 (0.71)	1152 (2.19)
Anemia	1006 (3.62)	73 (0.29)	1079 (2.05)
Gastritis	539 (1.94)	461 (1.86)	1000 (1.9)
Allergy	590 (2.13)	200 (0.81)	790 (1.5)
Severe constipation	346 (1.25)	295 (1.19)	641 (1.22)
Depression	614 (2.21)	11 (0.04)	625 (1.19)
Disorders of the lipoprotein metabolism	321 (1.16)	141 (0.57)	462 (0.88)
Hypertension	193 (0.7)	88 (0.35)	281 (0.53)
Chronic cholecystitis/gallstones	210 (0.76)	30 (0.12)	240 (0.46)
Obesity	173 (0.62)	26 (0.1)	199 (0.38)
COPD/asthma	124 (0.45)	51 (0.21)	175 (0.33)
Cancer	145 (0.52)	23 (0.09)	168 (0.32)
Diabetes	94 (0.34)	42 (0.17)	136 (0.26)
Severe vision reduction	102 (0.37)	31 (0.12)	133 (0.25)
Arthritis	89 (0.32)	35 (0.14)	124 (0.24)
Human Immunodeficiency Virus	94 (0.34)	30 (0.12)	124 (0.24)
Neuropathy	70 (0.25)	27 (0.11)	97 (0.18)
Hemorrhoids	52 (0.19)	37 (0.15)	89 (0.17)
Joint arthrosis	60 (0.22)	24 (0.1)	84 (0.16)
Thyroid dysfunction	75 (0.27)	8 (0.03)	83 (0.16)
Epilepsy	44 (0.16)	36 (0.15)	80 (0.15)
Malnutrition and cachexia	57 (0.21)	18 (0.07)	75 (0.14)
Cardiac disease	42 (0.15)	25 (0.1)	67 (0.13)
Anxiety	37 (0.13)	22 (0.09)	59 (0.11)
Tuberculosis	32 (0.12)	21 (0.08)	53 (0.1)
Mental and behavioral disorders	24 (0.09)	17 (0.07)	41 (0.08)
Chronic sinusitis	28 (0.1)	8 (0.03)	36 (0.07)

Chronic condition [n (prevalence)]	Female	Male	Total
Chronic kidney disease	14 (0.05)	12 (0.05)	26 (0.05)
Severe hearing loss	14 (0.05)	9 (0.04)	23 (0.04)
Hypotension	9 (0.03)	-	9 (0.03)
Sleep disorder	13 (0.05)	5 (0.02)	18 (0.03)
Sexual dysfunction	8 (0.03)	9 (0.04)	17 (0.03)
Brain infarction/hemorrhage	6 (0.02)	5 (0.02)	11 (0.02)
Liver-, gallbladder- and pancreas disease	7 (0.03)	5 (0.02)	12 (0.02)
Osteoporosis/osteoarthrosis	7 (0.03)	1 (0)	8 (0.02)
Psoriasis	4 (0.01)	7 (0.03)	11 (0.02)
Ulcer of the skin	5 (0.02)	4 (0.02)	9 (0.02)
Colitis ulcerous/Chron´s disease	5 (0.02)	2 (0.01)	7 (0.01)
Mental disorders due to alcohol	2 (0.01)	2 (0.01)	4 (0.01)
Multiple sclerosis	2 (0.01)	1 (0)	3 (0.01)
Parkinson disease	1 (0)	-	1 (0)
Dementia	-	1 (0)	1 (0)
Delirium	-	1 (0)	1 (0)
Mental disorders due to tobacco	-	1 (0)	1 (0)
Parathyroidism	-	1 (0)	1 (0)

Appendix 17 - Table. Prevalence of chronic conditions in AW Indigenous enrollees aged 45-64 years old, 2014-2017, data=AHR, n=14558

Chronic condition [n (prevalence)]	Female	Male	Total
Chronic pain	1058 (13.47)	515 (7.68)	1573 (10.81)
Chronic low back pain	925 (11.78)	633 (9.44)	1558 (10.7)
Hypertension	604 (7.69)	297 (4.43)	901 (6.19)
Genitourinary diseases	616 (7.84)	229 (3.42)	845 (5.8)
Dizziness	576 (7.33)	193 (2.88)	769 (5.28)
Disorders of the lipoprotein metabolism	418 (5.32)	188 (2.8)	606 (4.16)
Gastritis	308 (3.92)	227 (3.39)	535 (3.67)
Diabetes	280 (3.57)	162 (2.42)	442 (3.04)
Chronic periodontitis and gingivitis	239 (3.04)	125 (1.86)	364 (2.5)
Migraine/chronic headache	292 (3.72)	67 (1)	359 (2.47)
Anemia	303 (3.86)	41 (0.61)	344 (2.36)
Allergy	193 (2.46)	88 (1.31)	281 (1.93)
Severe constipation	134 (1.71)	100 (1.49)	234 (1.61)
Severe vision reduction	119 (1.52)	86 (1.28)	205 (1.41)
Chronic cholecystitis/gallstones	153 (1.95)	27 (0.4)	180 (1.24)
Joint arthrosis	129 (1.64)	48 (0.72)	177 (1.22)
Cancer	123 (1.57)	28 (0.42)	151 (1.04)
Arthritis	109 (1.39)	30 (0.45)	139 (0.95)
COPD/asthma	79 (1.01)	35 (0.52)	114 (0.78)
Obesity	73 (0.93)	21 (0.31)	94 (0.65)
Neuropathy	70 (0.89)	23 (0.34)	93 (0.64)
Cardiac disease	42 (0.53)	39 (0.58)	81 (0.56)
Thyroid dysfunction	50 (0.64)	7 (0.1)	57 (0.39)
Hemorrhoids	27 (0.34)	24 (0.36)	51 (0.35)
Tuberculosis	29 (0.37)	18 (0.27)	47 (0.32)
Chronic kidney disease	16 (0.2)	24 (0.36)	40 (0.27)
Brain infarction/hemorrhage	20 (0.25)	11 (0.16)	31 (0.21)
Depression	26 (0.33)	2 (0.03)	28 (0.19)
Severe hearing loss	18 (0.23)	5 (0.07)	23 (0.16)
Human Immunodeficiency Virus	12 (0.15)	10 (0.15)	22 (0.15)
Epilepsy	10 (0.13)	11 (0.16)	21 (0.14)
Malnutrition and cachexia	14 (0.18)	5 (0.07)	19 (0.13)

Chronic condition [n (prevalence)]	Female	Male	Total
Chronic sinusitis	10 (0.13)	9 (0.13)	19 (0.13)
Anxiety	11 (0.14)	6 (0.09)	17 (0.12)
Osteoporosis/osteoarthrosis	11 (0.14)	5 (0.07)	16 (0.11)
Sleep disorder	3 (0.04)	11 (0.16)	14 (0.1)
Liver-, gallbladder- and pancreas disease	8 (0.1)	4 (0.06)	12 (0.08)
Psoriasis	3 (0.04)	8 (0.12)	11 (0.08)
Mental disorders due to alcohol	-	5 (0.07)	5 (0.07)
Colitis ulcerous/Chron´s disease	4 (0.05)	3 (0.04)	7 (0.05)
Hypotension	4 (0.05)	3 (0.04)	7 (0.05)
Mental and behavioral disorders	3 (0.04)	5 (0.07)	8 (0.05)
Ulcer of the skin	5 (0.06)	2 (0.03)	7 (0.05)
Parkinson disease	2 (0.03)	4 (0.06)	6 (0.04)
Multiple sclerosis	2 (0.03)	-	2 (0.03)
Sexual dysfunction	1 (0.01)	4 (0.06)	5 (0.03)
Dementia	1 (0.01)	1 (0.01)	2 (0.01)
Parathyroidism	1 (0.01)	1 (0.01)	2 (0.01)

Appendix 18 - Table. Prevalence of chronic conditions in AW Indigenous enrollees aged 65+ years old, 2014-2017, data=AHR, n=9355

Chronic condition [n (prevalence)]	Female	Male	Total
Chronic pain	640 (12.14)	415 (10.17)	1055 (11.28)
Hypertension	562 (10.66)	378 (9.26)	940 (10.05)
Chronic low back pain	468 (8.88)	334 (8.18)	802 (8.57)
Severe vision reduction	260 (4.93)	244 (5.98)	504 (5.39)
Dizziness	296 (5.61)	186 (4.56)	482 (5.15)
Genitourinary diseases	201 (3.81)	239 (5.85)	440 (4.7)
Diabetes	248 (4.7)	135 (3.31)	383 (4.09)
Gastritis	195 (3.7)	122 (2.99)	317 (3.39)
Disorders of the lipoprotein metabolism	209 (3.96)	102 (2.5)	311 (3.32)
Anemia	128 (2.43)	84 (2.06)	212 (2.27)
Joint arthrosis	138 (2.62)	54 (1.32)	192 (2.05)
Severe constipation	96 (1.82)	73 (1.79)	169 (1.81)
COPD/asthma	97 (1.84)	54 (1.32)	151 (1.61)
Allergy	80 (1.52)	55 (1.35)	135 (1.44)
Cancer	74 (1.4)	53 (1.3)	127 (1.36)
Migraine/chronic headache	94 (1.78)	33 (0.81)	127 (1.36)
Cardiac disease	66 (1.25)	53 (1.3)	119 (1.27)
Chronic periodontitis and gingivitis	43 (0.82)	42 (1.03)	85 (0.91)
Chronic cholecystitis/gallstones	50 (0.95)	28 (0.69)	78 (0.83)
Arthritis	49 (0.93)	23 (0.56)	72 (0.77)
Chronic kidney disease	16 (0.3)	36 (0.88)	52 (0.56)
Brain infarction/hemorrhage	28 (0.53)	23 (0.56)	51 (0.55)
Neuropathy	31 (0.59)	15 (0.37)	46 (0.49)
Severe hearing loss	16 (0.3)	21 (0.51)	37 (0.4)
Tuberculosis	21 (0.4)	15 (0.37)	36 (0.38)
Obesity	18 (0.34)	5 (0.12)	23 (0.25)
Hemorrhoids	8 (0.15)	9 (0.22)	17 (0.18)
Anxiety	12 (0.23)	4 (0.1)	16 (0.17)
Thyroid dysfunction	13 (0.25)	3 (0.07)	16 (0.17)
Liver-, gallbladder- and pancreas disease	13 (0.25)	2 (0.05)	15 (0.16)
Ulcer of the skin	8 (0.15)	7 (0.17)	15 (0.16)
Dementia	9 (0.17)	5 (0.12)	14 (0.15)

Chronic condition [n (prevalence)]	Female	Male	Total
Osteoporosis/osteoarthrosis	9 (0.17)	4 (0.1)	13 (0.14)
Epilepsy	9 (0.17)	3 (0.07)	12 (0.13)
Sleep disorder	6 (0.11)	6 (0.15)	12 (0.13)
Hypotension	7 (0.13)	4 (0.1)	11 (0.12)
Malnutrition and cachexia	9 (0.17)	2 (0.05)	11 (0.12)
Parkinson disease	5 (0.09)	6 (0.15)	11 (0.12)
Colitis ulcerous/Chron´s disease	5 (0.09)	3 (0.07)	8 (0.09)
Depression	4 (0.08)	3 (0.07)	7 (0.07)
Psoriasis	1 (0.02)	6 (0.15)	7 (0.07)
Sexual dysfunction	-	3 (0.07)	3 (0.07)
Chronic sinusitis	3 (0.06)	1 (0.02)	4 (0.04)
Human Immunodeficiency Virus	1 (0.02)	1 (0.02)	2 (0.02)
Mental disorders due to alcohol	1 (0.02)	-	1 (0.02)
Mental and behavioral disorders	1 (0.02)	-	1 (0.02)
Parathyroidism	1 (0.02)	-	1 (0.02)
Delirium	-	1 (0.02)	1 (0.02)

Appendix 19 - Table. Prevalence of chronic conditions in AW Indigenous enrollees aged 18+ years old by the zone of residence, 2014-2017, data=AHR, n=76476

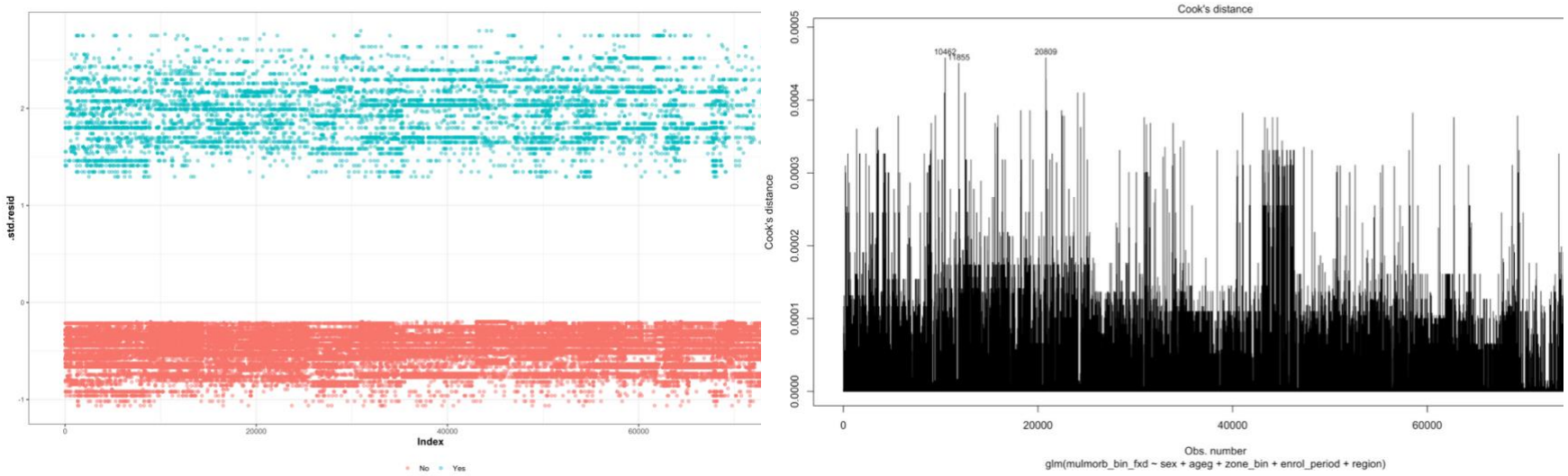
Chronic condition	Urban	Rural	Total
Chronic low back pain	741 (6.22)	4550 (7.05)	5291 (6.92)
Chronic pain	702 (5.89)	4209 (6.52)	4911 (6.42)
Genitourinary diseases	720 (6.05)	2416 (3.74)	3136 (4.1)
Dizziness	597 (5.01)	2305 (3.57)	2902 (3.79)
Hypertension	571 (4.79)	1551 (2.4)	2122 (2.77)
Gastritis	113 (0.95)	1739 (2.69)	1852 (2.42)
Chronic periodontitis and gingivitis	162 (1.36)	1669 (2.58)	1831 (2.39)
Anemia	223 (1.87)	1412 (2.19)	1635 (2.14)
Migraine/chronic headache	385 (3.23)	1253 (1.94)	1638 (2.14)
Disorders of the lipoprotein metabolism	356 (2.99)	1023 (1.58)	1379 (1.8)
Allergy	318 (2.67)	888 (1.38)	1206 (1.58)
Severe constipation	65 (0.55)	979 (1.52)	1044 (1.37)
Diabetes	233 (1.96)	728 (1.13)	961 (1.26)
Severe vision reduction	222 (1.86)	620 (0.96)	842 (1.1)
Depression	67 (0.56)	593 (0.92)	660 (0.86)
Chronic cholecystitis/gallstones	99 (0.83)	399 (0.62)	498 (0.65)
Joint arthrosis	109 (0.92)	344 (0.53)	453 (0.59)
Cancer	120 (1.01)	326 (0.5)	446 (0.58)
COPD/asthma	119 (1)	321 (0.5)	440 (0.58)
Arthritis	69 (0.58)	266 (0.41)	335 (0.44)
Obesity	106 (0.89)	210 (0.33)	316 (0.41)
Cardiac disease	74 (0.62)	193 (0.3)	267 (0.35)
Neuropathy	91 (0.76)	145 (0.22)	236 (0.31)
Hemorrhoids	66 (0.55)	91 (0.14)	157 (0.21)
Thyroid dysfunction	71 (0.6)	85 (0.13)	156 (0.2)
Human Immunodeficiency Virus	31 (0.26)	117 (0.18)	148 (0.19)
Tuberculosis	20 (0.17)	116 (0.18)	136 (0.18)
Chronic kidney disease	36 (0.3)	82 (0.13)	118 (0.15)
Epilepsy	38 (0.32)	75 (0.12)	113 (0.15)
Malnutrition and cachexia	16 (0.13)	89 (0.14)	105 (0.14)
Anxiety	37 (0.31)	55 (0.09)	92 (0.12)
Brain infarction/hemorrhage	24 (0.2)	69 (0.11)	93 (0.12)
Severe hearing loss	32 (0.27)	51 (0.08)	83 (0.11)
Chronic sinusitis	7 (0.06)	52 (0.08)	59 (0.08)

Chronic condition	Urban	Rural	Total
Mental and behavioral disorders	18 (0.15)	32 (0.05)	50 (0.07)
Sleep disorder	15 (0.13)	29 (0.04)	44 (0.06)
Liver-, gallbladder- and pancreas disease	11 (0.09)	28 (0.04)	39 (0.05)
Osteoporosis/osteoarthrosis	16 (0.13)	21 (0.03)	37 (0.05)
Hypotension	8 (0.07)	19 (0.03)	27 (0.04)
Psoriasis	6 (0.05)	23 (0.04)	29 (0.04)
Ulcer of the skin	9 (0.08)	22 (0.03)	31 (0.04)
Colitis ulcerous/Chron´s disease	5 (0.04)	17 (0.03)	22 (0.03)
Sexual dysfunction	8 (0.07)	17 (0.03)	25 (0.03)
Dementia	4 (0.03)	13 (0.02)	17 (0.02)
Parkinson disease	5 (0.04)	13 (0.02)	18 (0.02)
Mental disorders due to alcohol	2 (0.02)	8 (0.01)	10 (0.01)
Parathyroidism	2 (0.02)	2 (0)	4 (0.01)
Multiple sclerosis	2 (0.02)	3 (0)	5 (0.01)
Delirium	2 (0.02)	-	2 (0)
Mental disorders due to tobacco	1 (0.01)	-	1 (0)

Appendix 20 -Table. Variance Inflation Factor (VIF) for covariates, Multivariable Logistic Regression Model, outcome: Multimorbidity Yes/No

Model covariate	GVIF	Df	GVIF^(1/(2*Df))
Sex	1.0024	1	1.0012
Age group	1.0309	3	1.0051
Zone	1.0719	1	1.0353
Enrollment period	1.0563	2	1.0138
Region	1.0907	2	1.0219

Df: Degrees of freedom



Appendix 21 - Figure. Diagnostics for Multivariable logistic regression model (outcome: Multimorbidity Yes/No). Residuals checking (Top-left) and Influential observations (Top-right), 2014-2017, n=76476

Appendix 22 - Table. Estimated indicators from Agglomerative Hierarchical Clustering Analysis (HCA) performed for multimorbidity patterns identification among Indigenous enrollees, Ward's Method, 2014-2017

Population		n	n Chronic Conditions	Test	Clusters	Within Cluster Sum of squares	Average distance within	Average distance between	Ratio: Within/ between	Dunn2	Average silhouette width	Cluster 1 Size	Cluster 2 size	Cluster 3 Size	Cluster 4 Size	Cluster 5 Size	Cluster 6 Size	Cluster 7 Size
Total		8672	14	1	2	321.46	0.25	0.29	0.86	1.16	0.14	7060	1612	0	0	0	0	0
				2	3	294.64	0.24	0.28	0.84	1.12	0.11	4167	2893	1612	0	0	0	0
				3	4	269.32	0.22	0.28	0.8	1.06	0.12	2963	2893	1204	1612	0	0	0
				4	5	248.8	0.21	0.28	0.76	1.08	0.13	2963	1451	1204	1442	1612	0	0
				5	6	229.59	0.2	0.28	0.72	1.08	0.15	2963	724	1204	1442	1612	727	0
				6	7	211.6	0.19	0.28	0.69	1.05	0.16	2277	724	1204	1442	1612	686	727
Female	18+ years old	6218	21	1	2	118.97	0.18	0.23	0.8	1.24	0.2	5414	804	0	0	0	0	0
				2	3	110.1	0.17	0.21	0.83	1.06	0.12	2585	2829	804	0	0	0	0
				3	4	102.36	0.16	0.21	0.8	1.12	0.12	2585	1750	804	1079	0	0	0
				4	5	94.91	0.16	0.2	0.77	1.15	0.13	2585	617	804	1133	1079	0	0
				5	6	87.81	0.15	0.2	0.74	1.08	0.13	1438	1147	617	804	1133	1079	0
				6	7	81.58	0.14	0.2	0.7	1.08	0.14	1438	1147	617	804	1133	548	531
	18-44 years old	3312	12	1	2	136.08	0.26	0.33	0.81	1.21	0.19	2435	877	0	0	0	0	0
				2	3	119.59	0.24	0.32	0.77	1.19	0.18	1425	1010	877	0	0	0	0
				3	4	107.9	0.23	0.31	0.73	1.16	0.17	465	960	1010	877	0	0	0
				4	5	99.14	0.22	0.31	0.69	1.16	0.17	465	563	1010	877	397	0	0
				5	6	90.53	0.2	0.31	0.66	1.2	0.15	465	563	1010	637	397	240	0
				6	7	82.51	0.19	0.31	0.63	1.29	0.15	465	563	762	637	397	240	248
	45-64 years old	1811	19	1	2	50.76	0.22	0.25	0.86	1.12	0.14	1401	410	0	0	0	0	0
				2	3	47.22	0.21	0.25	0.84	1.1	0.12	1072	410	329	0	0	0	0
				3	4	43.97	0.2	0.25	0.81	1.15	0.11	750	410	329	322	0	0	0
				4	5	41.58	0.19	0.25	0.78	1.14	0.12	126	410	624	329	322	0	0
				5	6	39.67	0.19	0.25	0.76	1.09	0.11	126	410	505	329	322	119	0
				6	7	37.77	0.18	0.25	0.74	1.09	0.11	126	410	505	217	322	119	112
	65+ years old	1095	17	1	2	33.17	0.23	0.27	0.83	1.14	0.16	922	173	0	0	0	0	0
				2	3	29.61	0.21	0.26	0.8	1.07	0.14	462	460	173	0	0	0	0
				3	4	27.32	0.2	0.26	0.77	1.15	0.15	462	253	173	207	0	0	0
				4	5	25.49	0.19	0.26	0.74	1.07	0.14	315	253	147	173	207	0	0
				5	6	24.09	0.19	0.26	0.72	0.92	0.11	211	104	253	147	173	207	0
				6	7	22.7	0.18	0.26	0.7	0.92	0.11	211	104	139	147	173	207	114
Male	18+ years old	2395	17	1	2	50.11	0.18	0.24	0.76	1.22	0.24	1920	475	0	0	0	0	0
				2	3	44.32	0.17	0.23	0.74	1.06	0.2	1568	352	475	0	0	0	0
				3	4	38.66	0.16	0.22	0.69	1	0.22	1240	352	475	328	0	0	0

Population		n	n Chronic Conditions	Test	Clusters	Within Cluster Sum of squares	Average distance within	Average distance between	Ratio: Within/ between	Dunn2	Average silhouette width	Cluster 1 Size	Cluster 2 size	Cluster 3 Size	Cluster 4 Size	Cluster 5 Size	Cluster 6 Size	Cluster 7 Size
				4	5	35.16	0.15	0.22	0.67	0.92	0.22	428	812	352	475	328	0	0
				5	6	32.02	0.14	0.22	0.63	0.91	0.25	226	812	352	475	328	202	0
				6	7	29.44	0.13	0.21	0.6	0.83	0.23	226	304	352	475	508	328	202
	18-44 years old	853	7	1	2	51.66	0.3	0.39	0.77	1.25	0.22	231	622	0	0	0	0	0
				2	3	42.19	0.26	0.39	0.68	1.34	0.26	231	409	213	0	0	0	0
				3	4	34.4	0.23	0.39	0.59	1.38	0.31	231	409	105	108	0	0	0
				4	5	27.69	0.2	0.39	0.52	1.35	0.31	98	409	105	133	108	0	0
				5	6	21.15	0.17	0.38	0.45	1.17	0.36	98	182	105	227	133	108	0
				6	7	15.54	0.15	0.38	0.38	1.34	0.41	98	91	105	227	133	108	91
	45-64 years old	818	12	1	2	31.27	0.25	0.32	0.77	1.29	0.22	564	254	0	0	0	0	0
				2	3	26.58	0.23	0.32	0.72	1.22	0.23	437	254	127	0	0	0	0
				3	4	23.41	0.21	0.31	0.67	1.08	0.23	341	254	127	96	0	0	0
				4	5	21.05	0.2	0.31	0.64	1.24	0.23	341	187	127	96	67	0	0
				5	6	19.4	0.19	0.31	0.61	1.17	0.24	287	187	127	96	67	54	0
				6	7	17.78	0.18	0.3	0.59	1.06	0.23	113	174	187	127	96	67	54
	65+ years old	724	17	1	2	22.17	0.23	0.27	0.83	1.15	0.15	630	94	0	0	0	0	0
				2	3	19.79	0.21	0.26	0.81	1.12	0.11	461	169	94	0	0	0	0
				3	4	18.09	0.2	0.26	0.77	1.14	0.11	86	375	169	94	0	0	0
				4	5	16.51	0.19	0.26	0.74	1.16	0.13	86	81	169	94	294	0	0
				5	6	15.34	0.18	0.26	0.71	1.09	0.13	86	81	169	94	213	81	0
				6	7	14.39	0.18	0.26	0.69	1.12	0.15	86	81	169	94	52	161	81

*Six models were performed per stratum.

Appendix 23 - Table. Percentage of the population suffering from chronic conditions according to Multimorbidity cluster, Total population aged 18+ years old, 2014-2017, n=8672

Condition/Cluster (%)	**1**	**2**	**3**	**4**	**5**
Anemia	2.7	14.7	2	51.4	7
Disorders of the lipoprotein metabolism	3	3.4	7.6	9.6	48.1
Migraine/chronic headache	3.5	50.7	2.5	12.4	6.5
Chronic periodontitis and gingivitis	6.1	59.1	1.3	0.4	3.9
Severe vision reduction	6.2	2.3	6.7	4.7	17.9
Dizziness	6.5	17.2	19.8	68	24.8
Diabetes	6.8	0.8	8.7	2.9	30
Genitourinary diseases	10.2	17	99.8	18.2	7.8
Severe constipation	15.2	2.3	1.2	1.7	2
Hypertension	16.7	4.5	20.2	2.8	56.8
Allergy	16.7	4.7	8.6	4.7	2.5
Gastritis	24.9	3.2	1.9	3.5	7
Chronic low back pain	50.3	38	32.4	32	17.7
Chronic pain	57.1	23.1	34.1	33.3	18.8
n (%row)	**2963 (34.2)**	**1451 (16.7)**	**1204 (13.9)**	**1442 (16.6)**	**1612 (18.6)**

Appendix 24 - Table. Percentage of the population suffering from chronic conditions according to Multimorbidity cluster, Female population aged 18+ years old, 2014-2017 period, data=AHR, n=6218

Condition/Cluster	**1**	**2**	**3**	**4**	**5**
Cardiac disease	0.3	0.2	4.7	1.1	-
COPD/asthma	1.3	1.1	10	1.8	0.3
Diabetes	1.7	0.8	47.8	3	1
Severe vision reduction	1.9	0.3	8	17.9	0.8
Chronic cholecystitis/gallstones	2.1	0.8	3.1	2.7	0.3
Arthritis	2.4	0.6	2	1.3	0.1
Anemia	3.2	100	5.6	19.5	6.4
Cancer	3.4	1	3.7	2.4	0.3
Hypertension	3.6	1.9	92.3	9.9	2.6
Depression	3.9	10.5	-	0.6	27.1
Joint arthrosis	4.1	1.8	9.5	4.1	0.2
Chronic periodontitis and gingivitis	7	15.7	1.4	1.3	51.7
Migraine/chronic headache	8	11.7	5.6	8.6	52.2
Disorders of the lipoprotein metabolism	8.9	1.8	15.8	35.7	3.7
Dizziness	9.5	12	19	71.2	30.7
Severe constipation	10.5	3.4	2.7	1.1	2.6
Allergy	16.2	6.2	4.2	3	6.3
Gastritis	19.1	6.3	3.7	1.6	2.1
Genitourinary diseases	39.5	26.7	16.5	18.8	8.2
Chronic low back pain	46.4	26.1	25.4	20.7	35.6
Chronic pain	47.2	29.5	31.8	33.2	17.4
n (%row)	**2585 (41.6)**	**617 (9.9)**	**804 (12.9)**	**1133 (18.2)**	**1079 (17.4)**

Appendix 25 - Table. Percentage of the population suffering from chronic conditions according to Multimorbidity cluster, Male population aged 18+ years old, 2014-2017 period, data=AHR, n=2395

Condition/Cluster	**1**	**2**	**3**	**4**
Cancer	0.7	6.5	4	-
Cardiac disease	1	2.6	5.1	-
COPD/asthma	1.2	2	4.8	0.3
Gastritis	1.5	2.6	2.5	100
Anemia	2.6	2.3	5.9	-
Joint arthrosis	3	0.6	1.9	0.9
Allergy	4.4	3.4	6.1	2.4
Severe vision reduction	4.8	4	36.4	-
Diabetes	5.2	9.9	32.6	2.4
Genitourinary diseases	5.5	99.4	7.8	18.6
Disorders of the lipoprotein metabolism	6.4	6	28.4	0.3
Severe constipation	9.2	2.6	3.6	18.9
Hypertension	11.5	22.4	66.9	5.2
Chronic periodontitis and gingivitis	17.2	3.1	2.9	-
Dizziness	22.5	10.2	27.6	1.2
Chronic low back pain	56.5	37.2	6.1	41.2
Chronic pain	56.9	32.7	15.6	31.7
n (%row)	**1240 (51.8)**	**352 (14.7)**	**475 (19.8)**	**328 (13.7)**

Appendix 26 - Table. Multimorbidity patterns in the Indigenous population, 2014-2017 period

Chronic conditions with a sex-specific prevalence > 1%

ID	Chronic condition
alle	Allergy
anem	Anemia
clbp	Chronic low back pain
cons	Severe constipation
cpai	Chronic pain
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
lipo	Disorders of the lipoprotein metabolism
migr	Migraine/chronic headache
prio	Chronic periodontitis and gingivitis
svre	Severe vision reduction

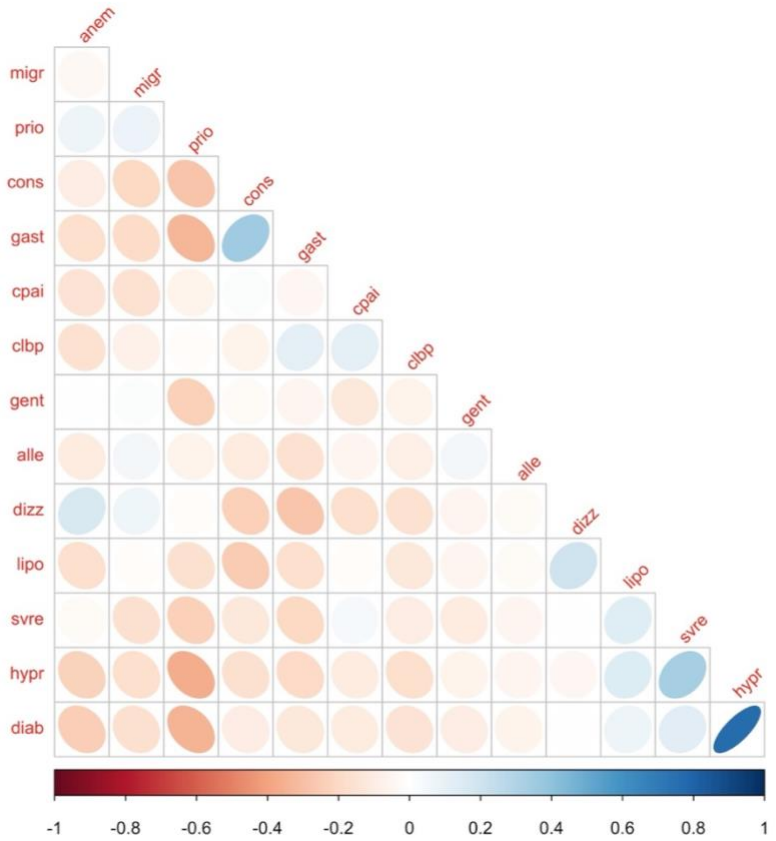
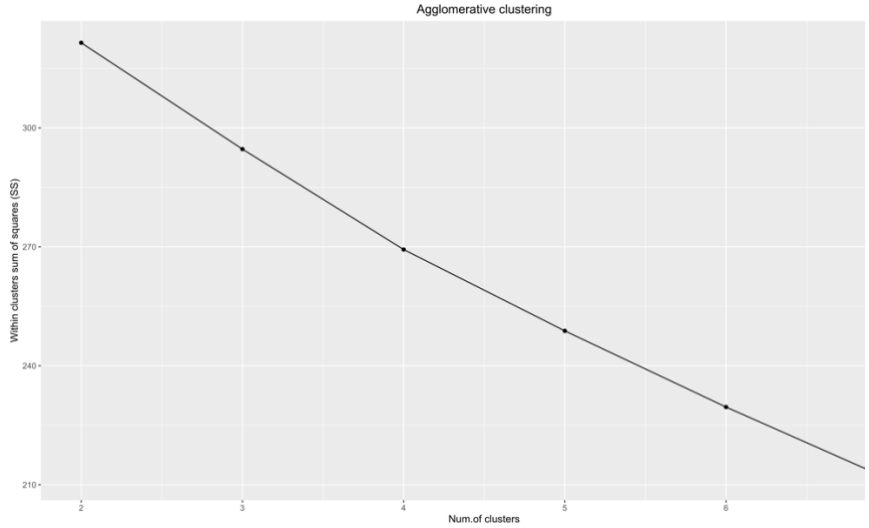
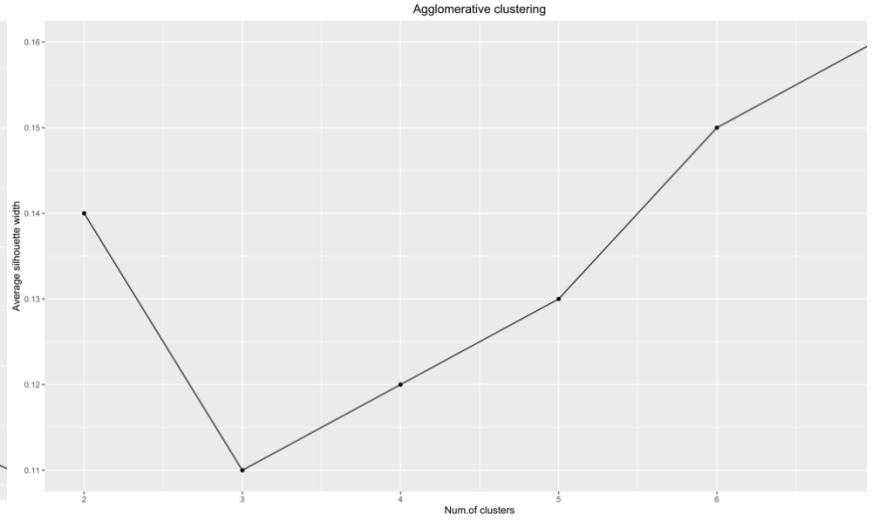


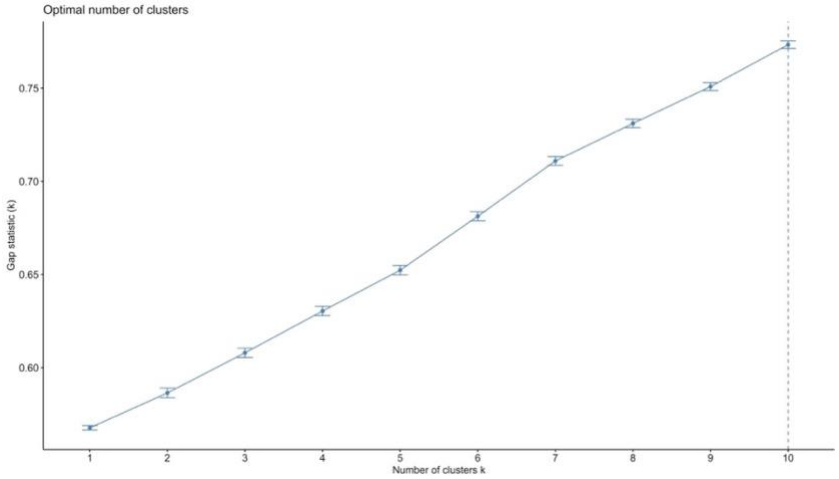
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

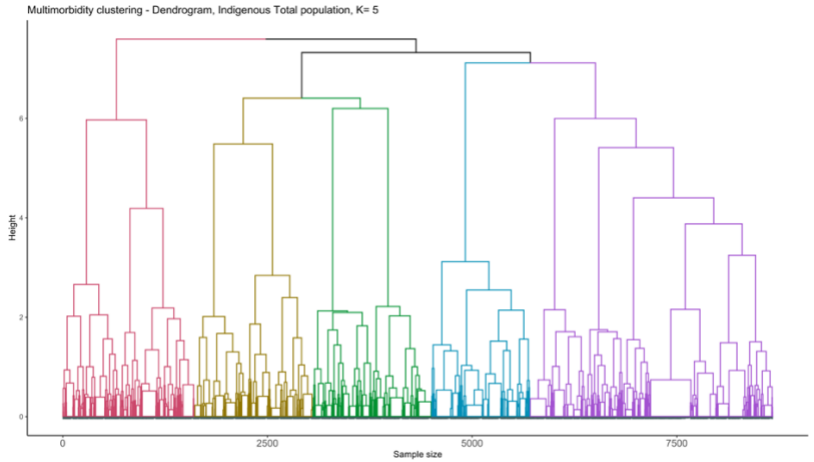
Appendix 27 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 6218.

The model for k=5 clusters is displayed (Bottom-right) for the indigenous population suffering from Chronic conditions whose sex-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom-left: representation of Gap statistic method; Bottom-right: Dendrogram.






Optimal number of clusters
Gap statistic (k)
0.75
0.70
0.65
0.60
1
2
3
4
5
6
7
8
9
10
Number of clusters k

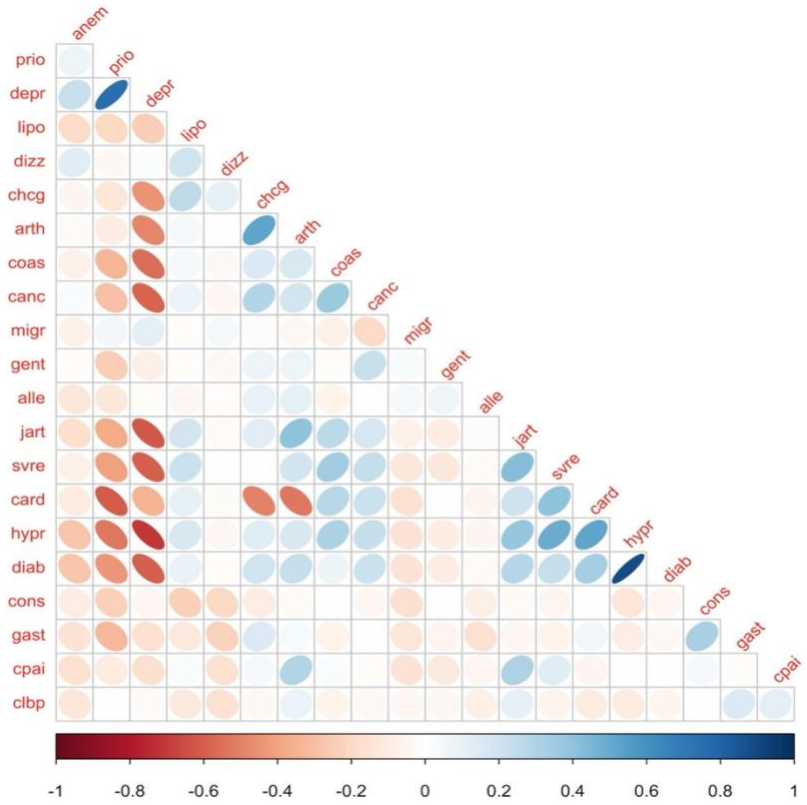

Multimorbidity clustering - Dendrogram, Indigenous Total population, K= 5
Height
6
4
2
0
0
2500
5000
7500
Sample size

Appendix 28 - Table. Multimorbidity patterns in the total Indigenous Female population, 2014-2017

Chronic conditions with a sex-specific prevalence > 1%

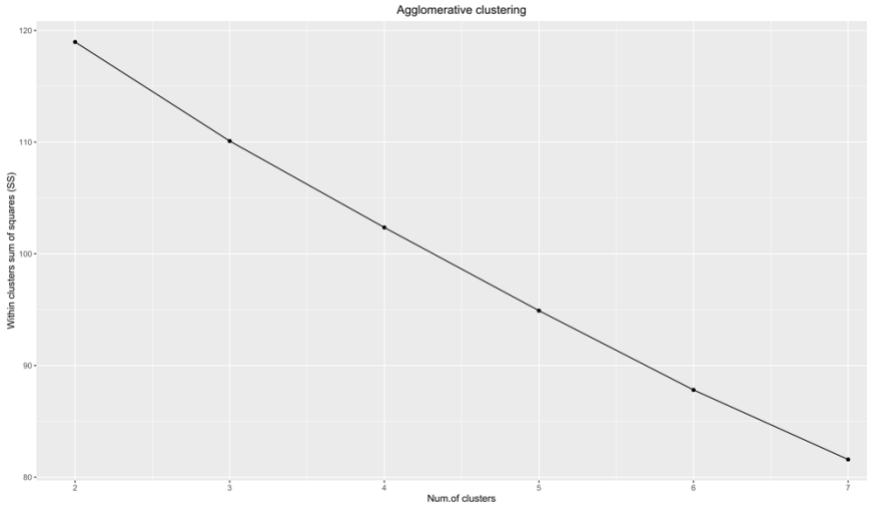
ID	Chronic condition
alle	Allergy
anem	Anemia
arth	Arthritis
canc	Cancer
card	Cardiac disease
chcg	Chronic cholecystitis/gallstones
clbp	Chronic low back pain
coas	COPD/asthma
cons	Severe constipation
cpai	Chronic pain
depr	Depression
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
jart	Joint arthrosis
lipo	Disorders of the lipoprotein metabolism
migr	Migraine/chronic headache
prio	Chronic periodontitis and gingivitis
svre	Severe vision reduction

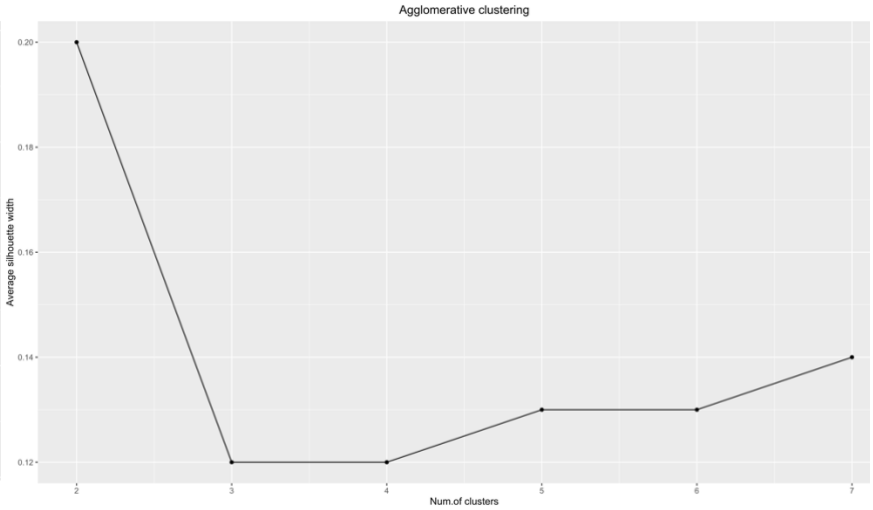
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

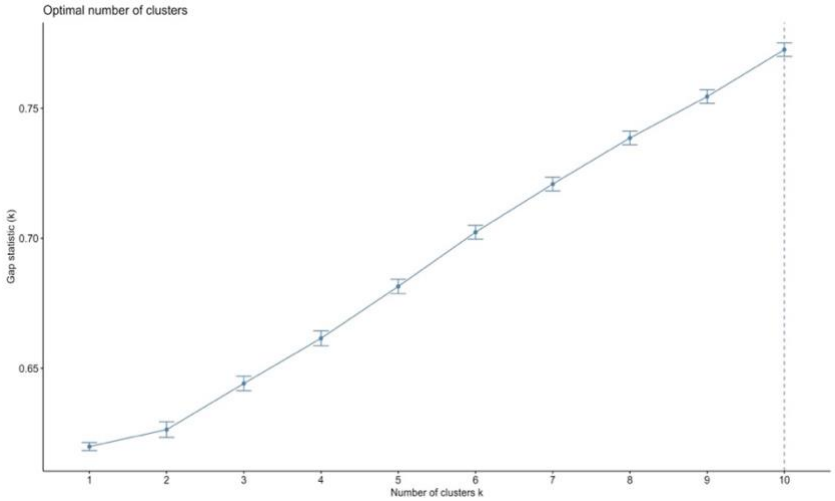


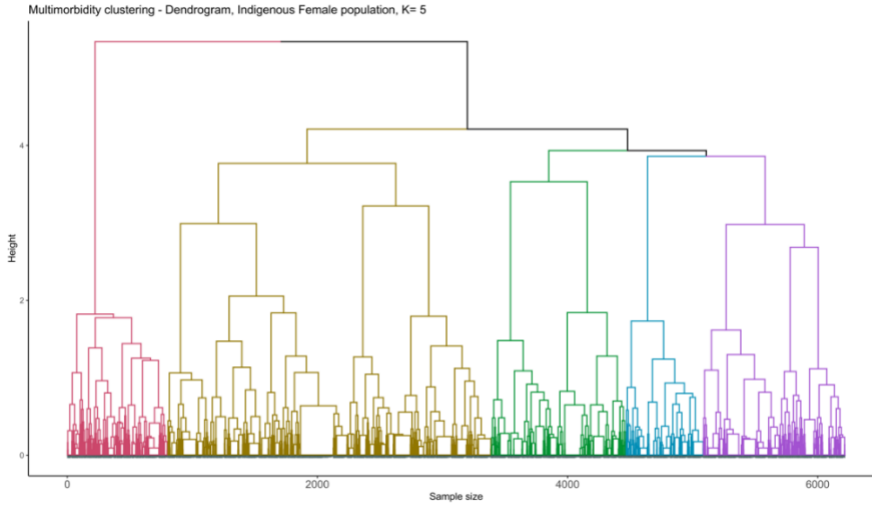
Appendix 29 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 6218

The model for k=5 clusters is displayed (Bottom-right) for the indigenous female population suffering from Chronic conditions whose sex-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom-left: representation of Gap statistic method; Bottom-right: Dendrogram.






Optimal number of clusters
Gap statistic (k)
0.75
0.70
0.65
1
2
3
4
5
6
7
8
9
10
Number of clusters k

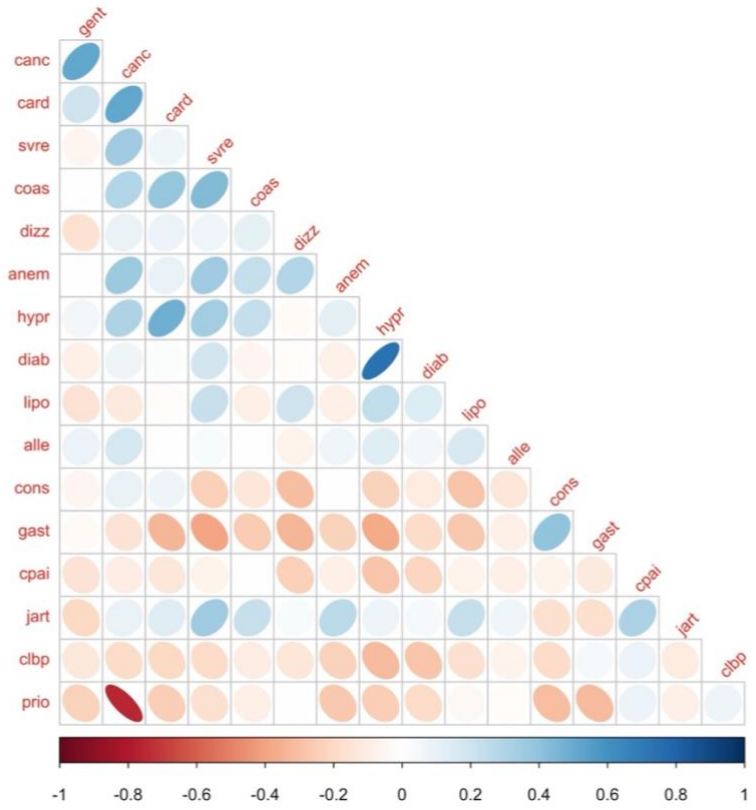

Multimorbidity clustering - Dendrogram, Indigenous Female population, K= 5
Height
4
2
0
0
2000
4000
6000
Sample size

Appendix 30 - Table. Multimorbidity patterns in the total Indigenous Male population, 2014-2017

Chronic conditions with a sex-specific prevalence > 1%

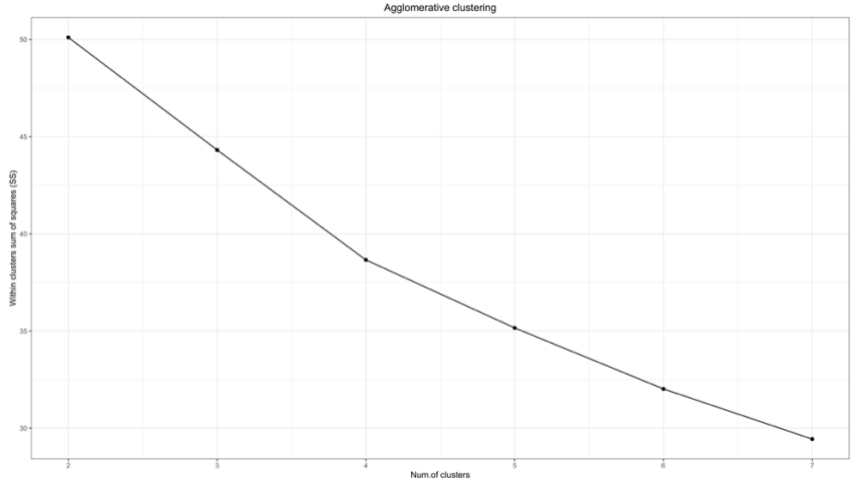
ID	Chronic condition
alle	Allergy
anem	Anemia
canc	Cancer
card	Cardiac disease
clbp	Chronic low back pain
coas	COPD/asthma
cons	Severe constipation
cpai	Chronic pain
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
jart	Joint arthrosis
lipo	Disorders of the lipoprotein metabolism
prio	Chronic periodontitis and gingivitis
svre	Severe vision reduction

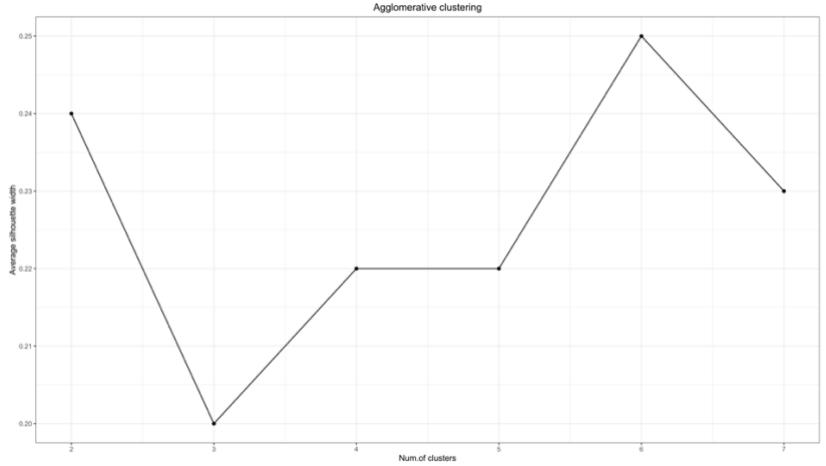
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

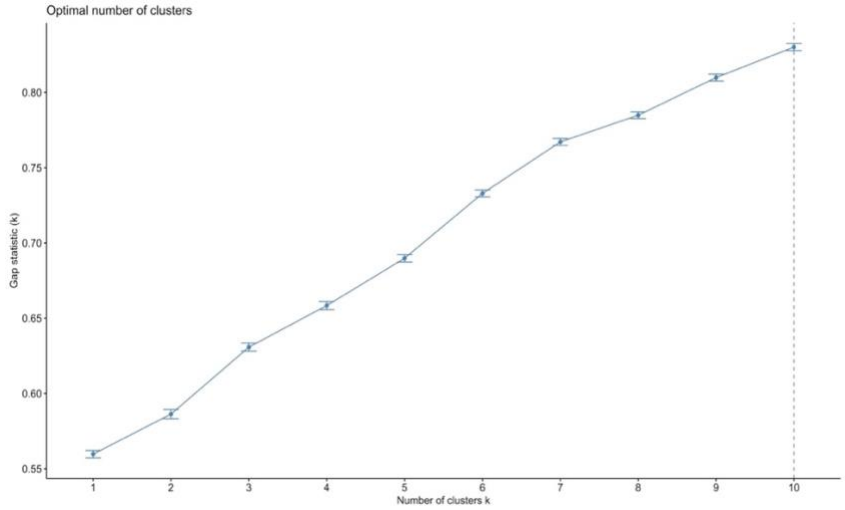


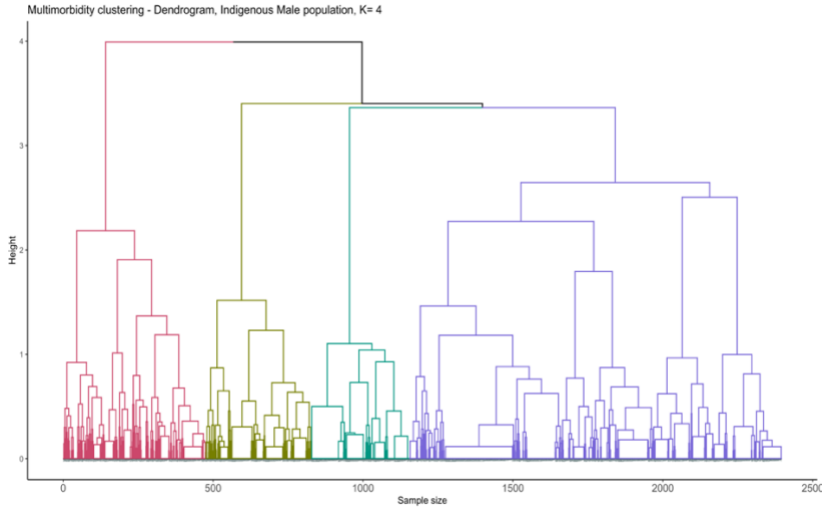
Appendix 31 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 2395.

The model for k=4 clusters is displayed (Bottom-right) for the indigenous Male population suffering from Chronic conditions whose sex-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom-left: representation of Gap statistic method; Bottom-right: Dendrogram.






Optimal number of clusters
Gap statistic (k)
0.80
0.75
0.70
0.65
0.60
0.55
1
2
3
4
5
6
7
8
9
10
Number of clusters k

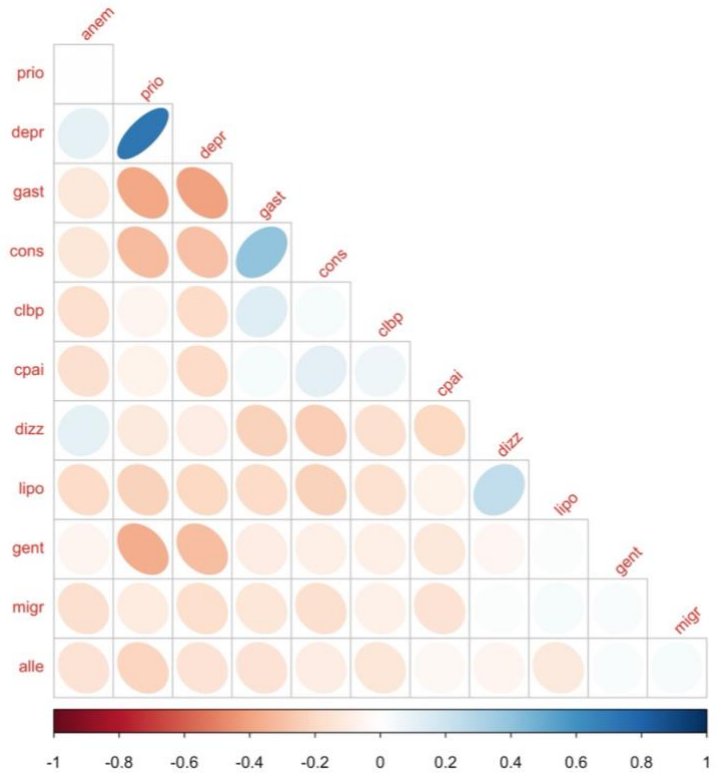

Multimorbidity clustering - Dendrogram, Indigenous Male population, K= 4
Height
4
3
2
1
0
0
500
1000
1500
2000
2500
Sample size

Appendix 32 - Table. Multimorbidity patterns in Indigenous Female population, 18-44 years old, 2014-2017

Chronic conditions with a sex- and age-specific prevalence > 1%

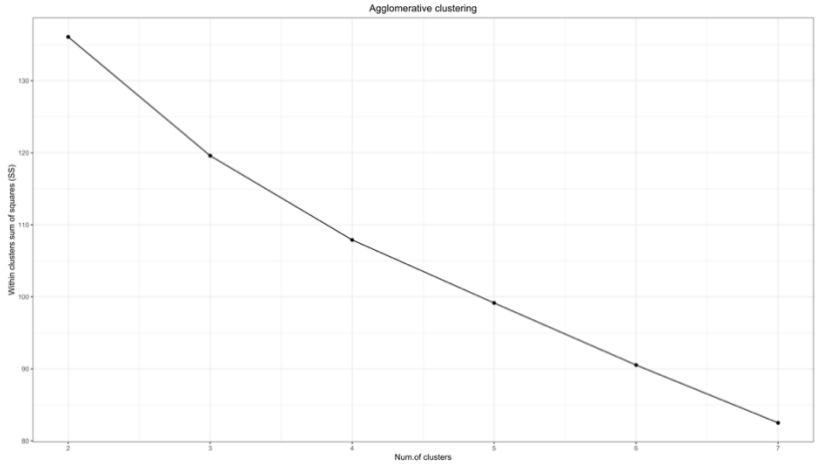
ID	Chronic condition
alle	Allergy
anem	Anemia
clbp	Chronic low back pain
cons	Severe constipation
cpai	Chronic pain
depr	Depression
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
lipo	Disorders of the lipoprotein metabolism
migr	Migraine/chronic headache
prio	Chronic periodontitis and gingivitis

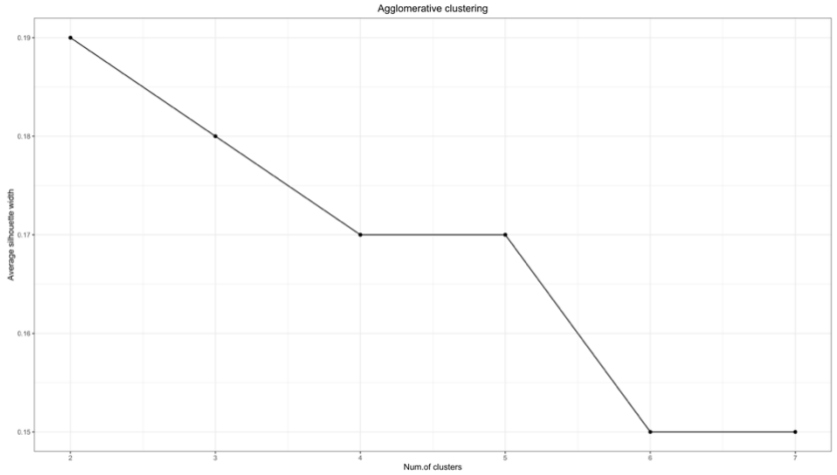
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

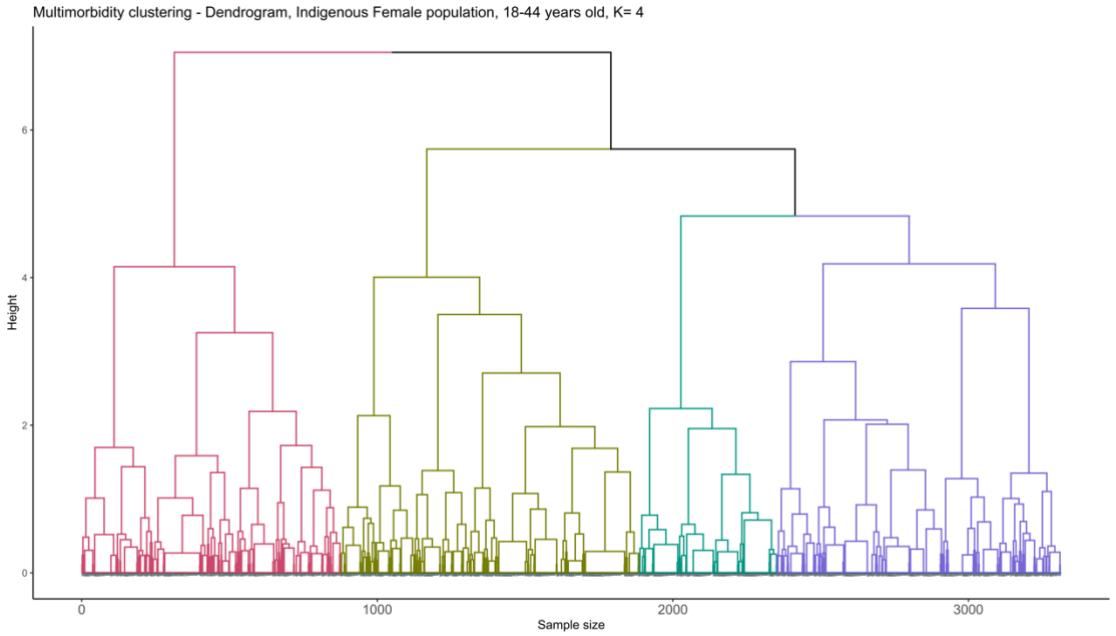


Appendix 33 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 3312.

The model for k=4 clusters is displayed (Bottom-right) for the indigenous female population aged 18-44 years old suffering from Chronic conditions whose sex- and age-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom: Dendrogram.

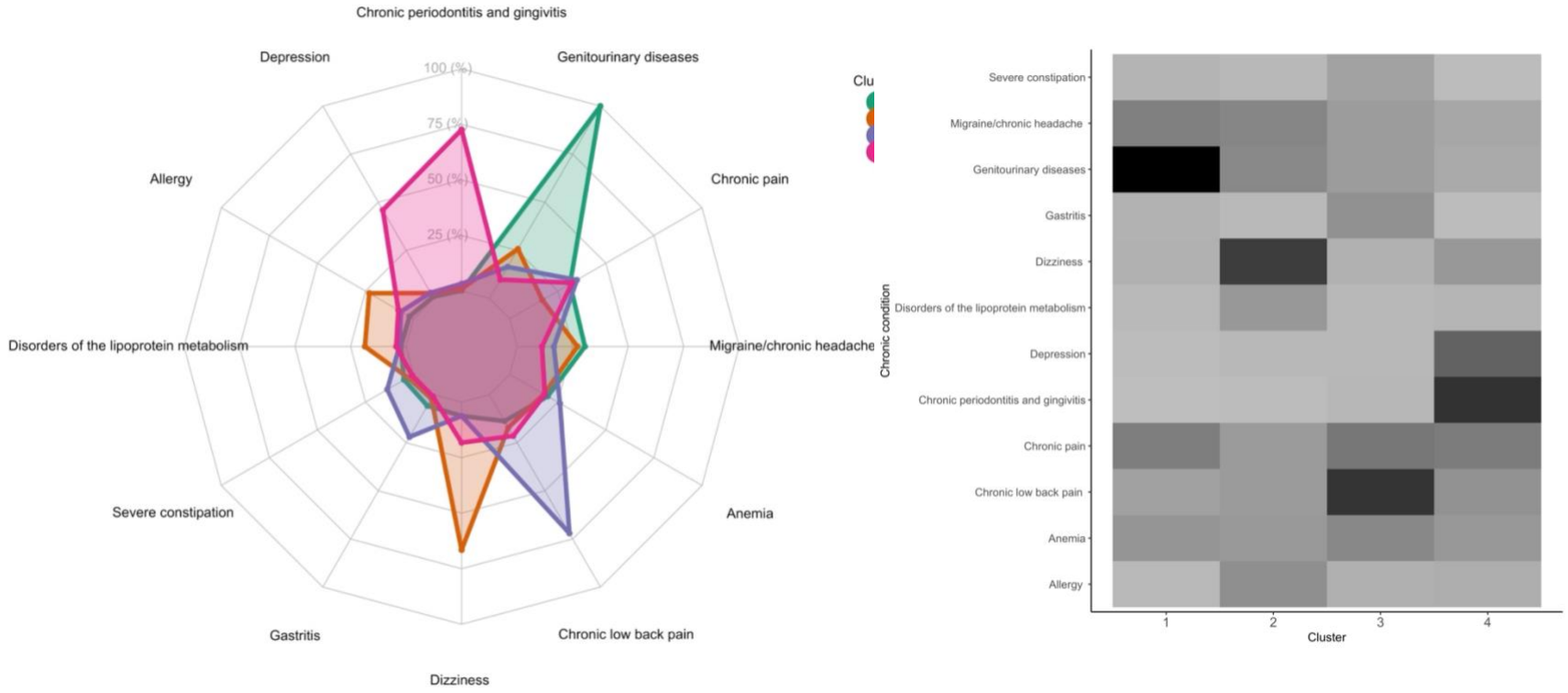





Multimorbidity clustering - Dendrogram, Indigenous Female population, 18-44 years old, K= 4
Height
6
4
2
0
0
1000
2000
3000
Sample size

Appendix 34 - Figure. Multimorbidity patterns in the Female indigenous population aged 18-44 years old (Left), 2014-2017 period, n= 3312

Distribution of enrollees by cluster is represented (right)

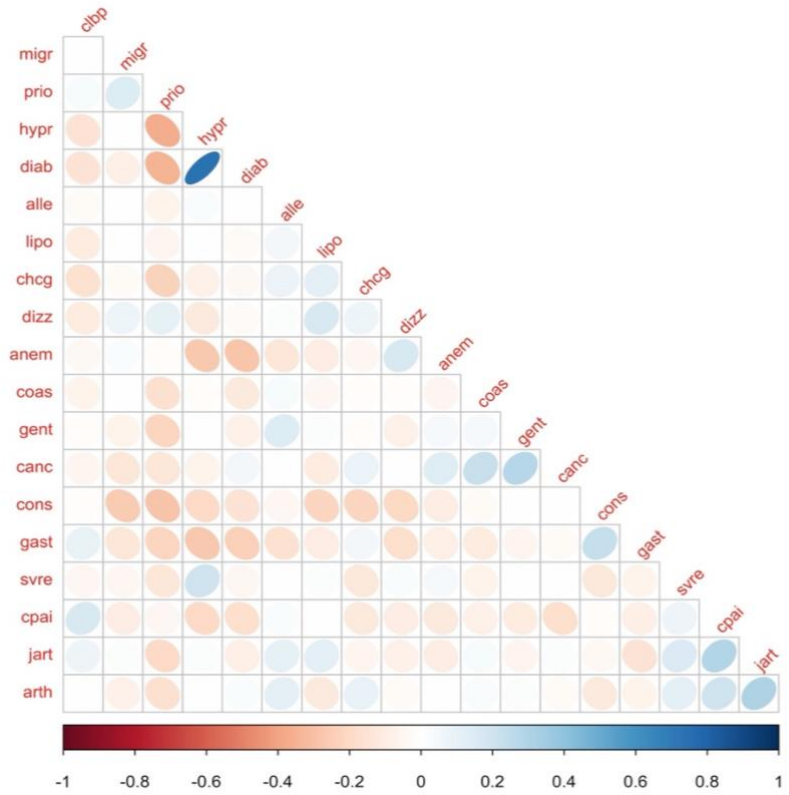


Appendix 35 - Table. Multimorbidity patterns in Indigenous Female population, 45-64 years old, 2014-2017

Chronic conditions with a sex- and age-specific prevalence > 1%

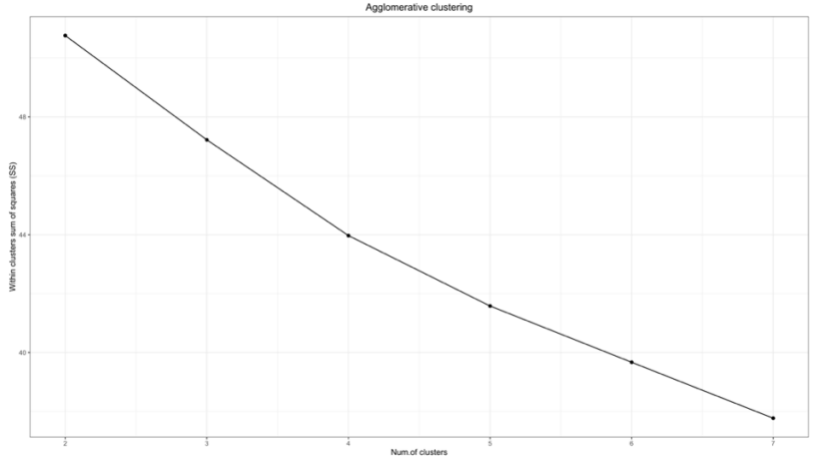
ID	Chronic condition
alle	Allergy
anem	Anemia
arth	Arthritis
canc	Cancer
chcg	Chronic cholecystitis/gallstones
clbp	Chronic low back pain
coas	COPD/asthma
cons	Severe constipation
cpai	Chronic pain
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
jart	Joint arthrosis
lipo	Disorders of the lipoprotein metabolism
migr	Migraine/chronic headache
prio	Chronic periodontitis and gingivitis
svre	Severe vision reduction

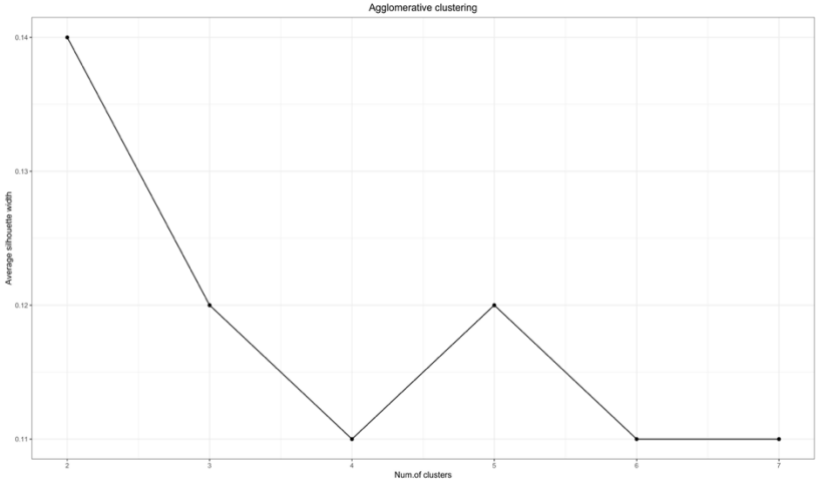
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

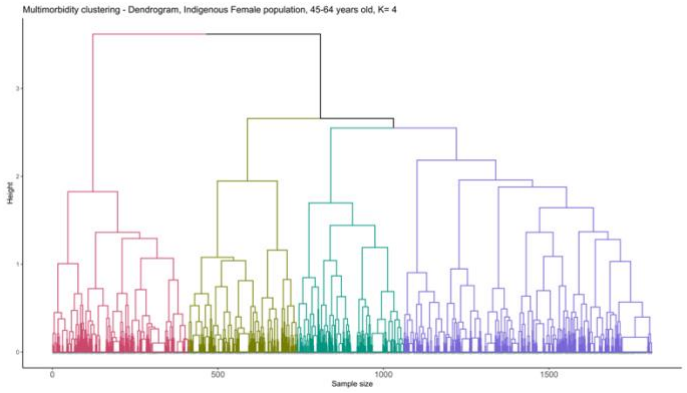


Appendix 36 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 1811

The model for k=4 clusters is displayed (Bottom-right) for the indigenous female population aged 45-64 years old suffering from Chronic conditions whose sex- and age-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom: Dendrogram.

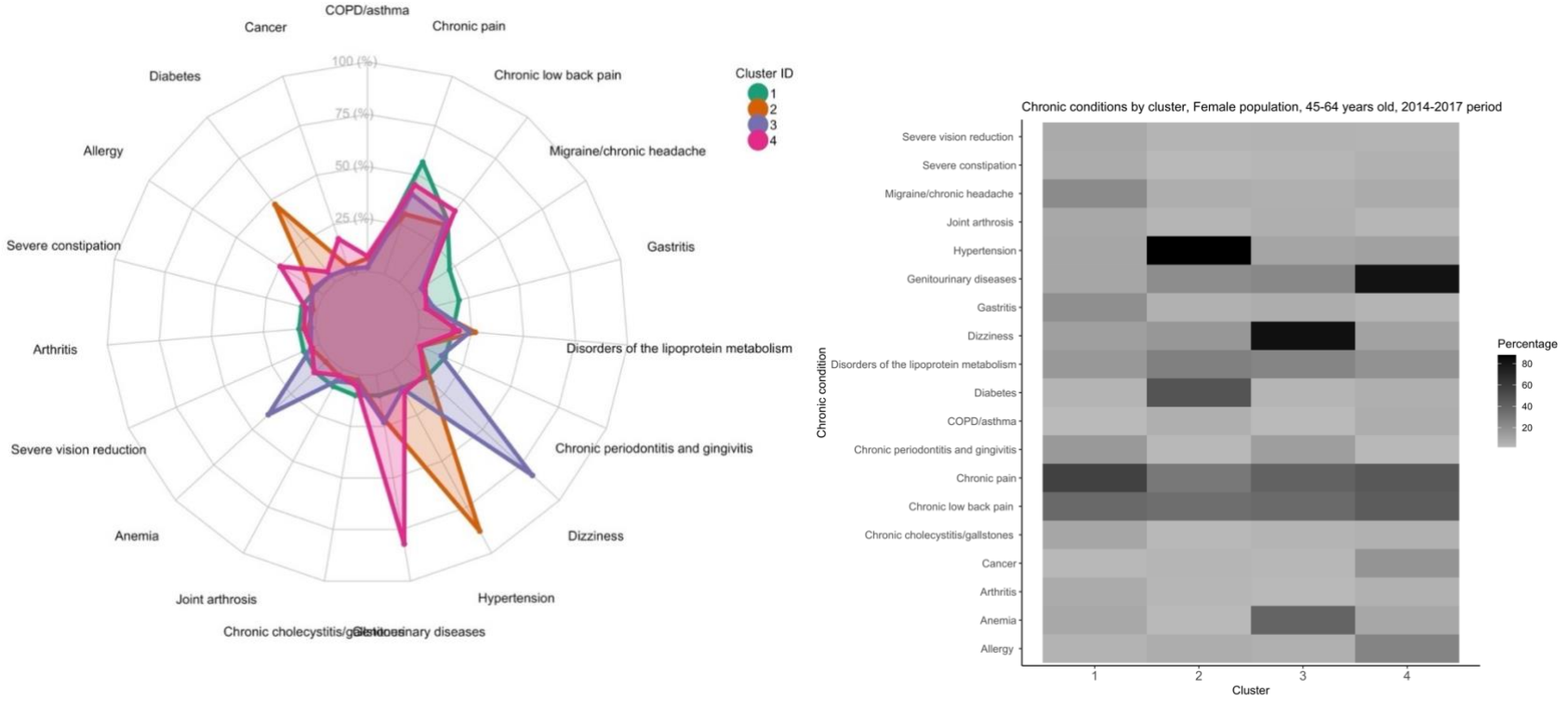






Appendix 37 - Figure. Multimorbidity patterns in the Female indigenous population aged 45-64 years old (Left), 2014-2017 period, n= 1811

Distribution of enrollees by cluster is represented (right)

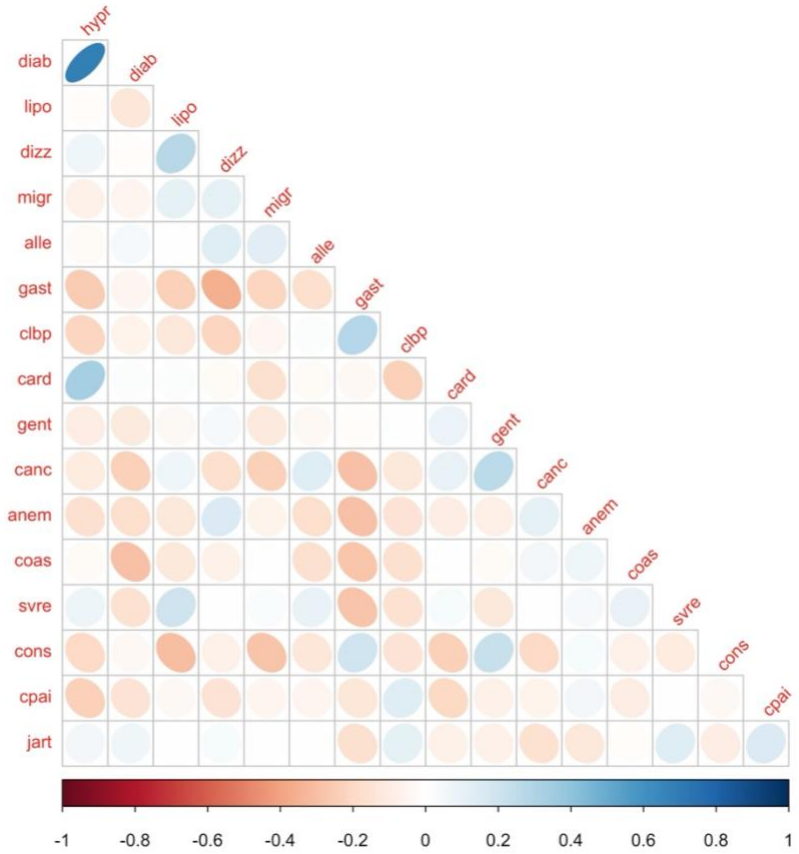


Appendix 38 - Table. Multimorbidity patterns in Indigenous Female population, 65+ years old, 2014-2017

Chronic conditions with a sex- and age-specific prevalence > 1%

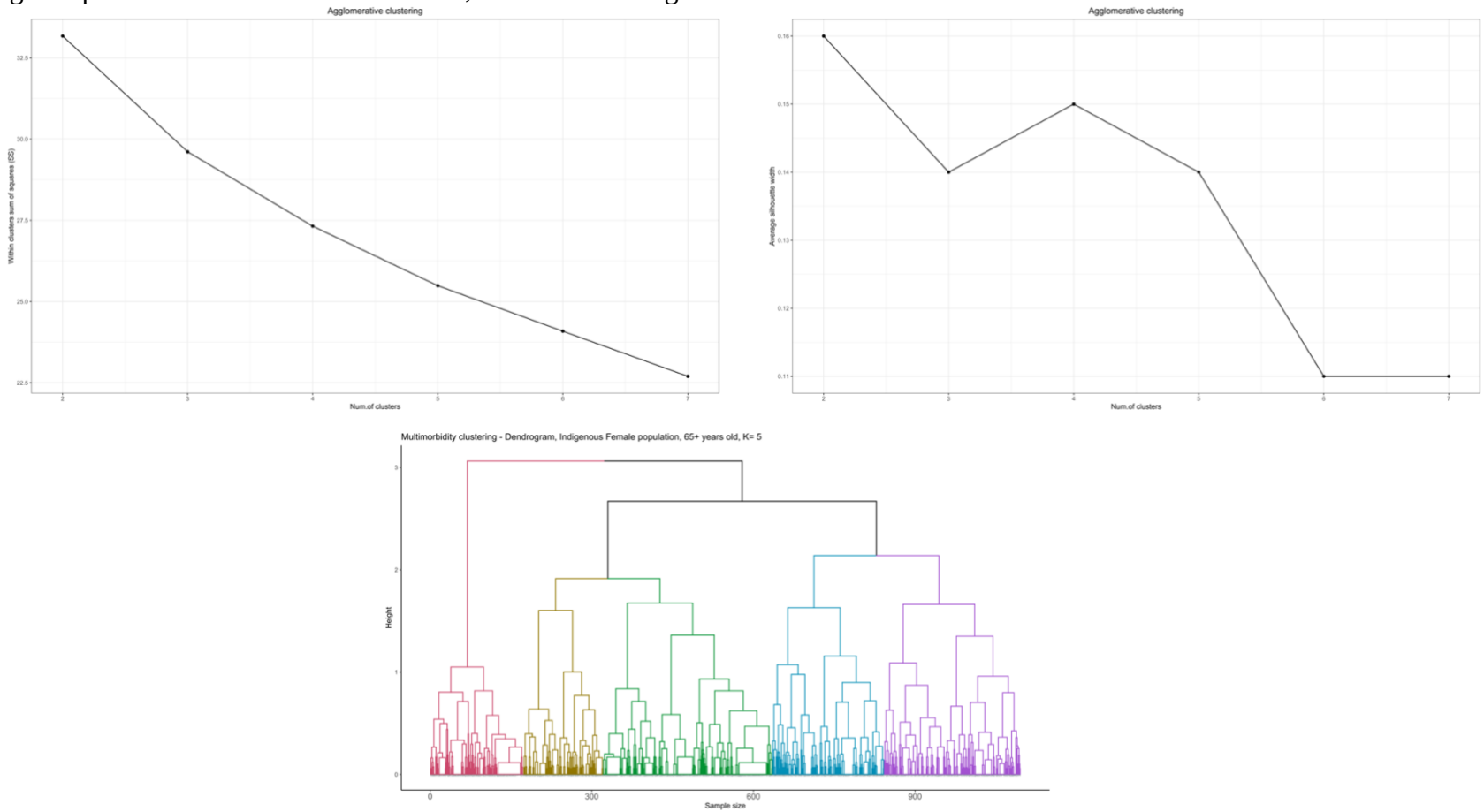
ID	Chronic condition
alle	Allergy
anem	Anemia
canc	Cancer
card	Cardiac disease
clbp	Chronic low back pain
coas	COPD/asthma
cons	Severe constipation
cpai	Chronic pain
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
jart	Joint arthrosis
lipo	Disorders of the lipoprotein metabolism
migr	Migraine/chronic headache
svre	Severe vision reduction

Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

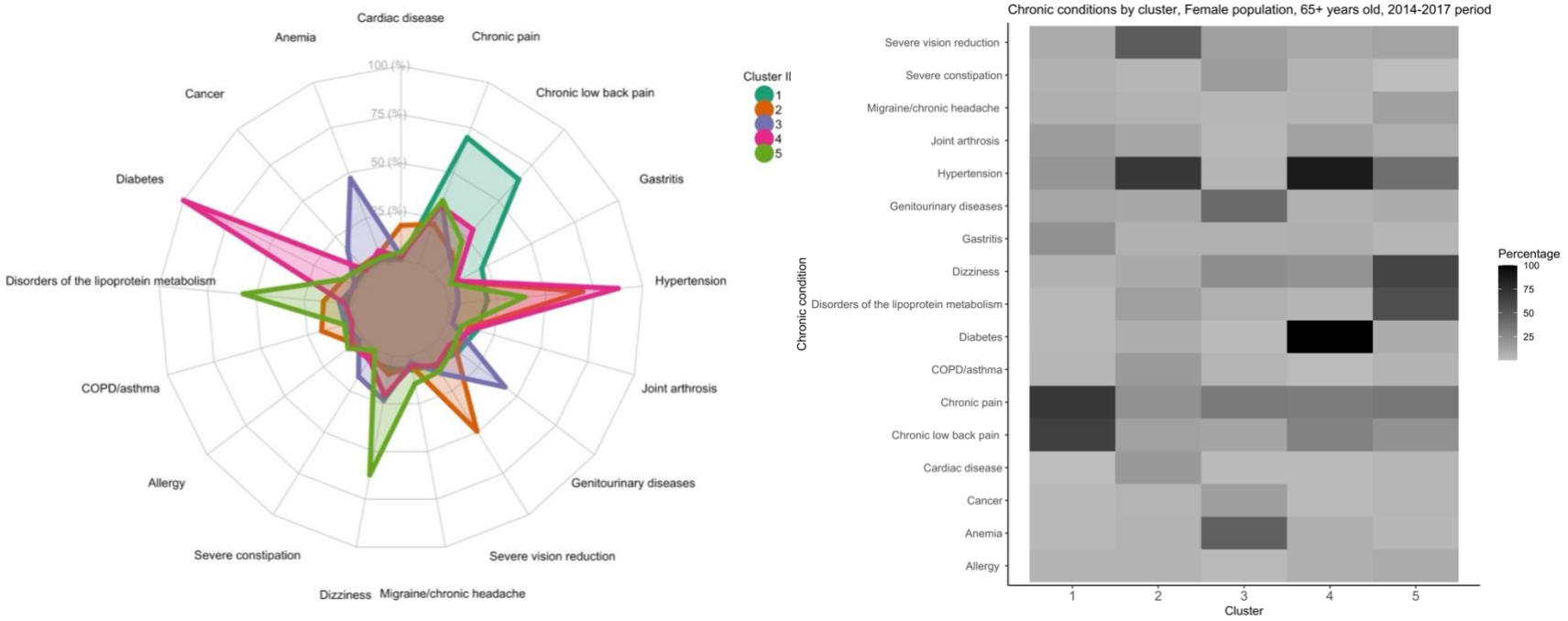


Appendix 39 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 1095

The model for k=5 clusters is displayed (Bottom-right) for the indigenous female population aged 65+ years old suffering from Chronic conditions whose sex- and age-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom: Dendrogram.



Appendix 40 - Figure. Multimorbidity patterns in the Female indigenous population aged 65+ years old (Left), 2014-2017 period, n= 1095. Distribution of enrollees by cluster is represented (right)

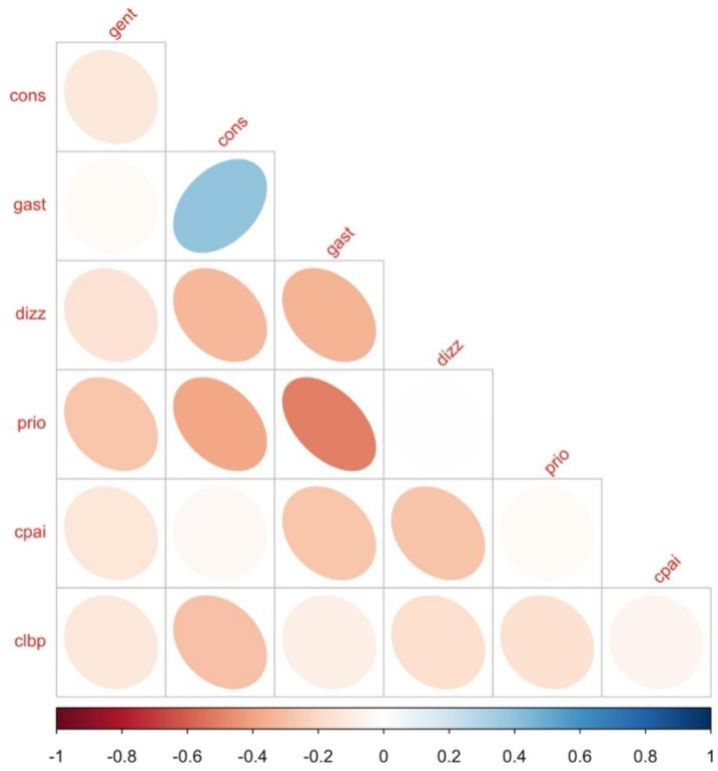


Appendix 41 - Table. Multimorbidity patterns in Indigenous Male population, 18-44 years old, 2014-2017

Chronic conditions with a sex- and age-specific prevalence > 1%

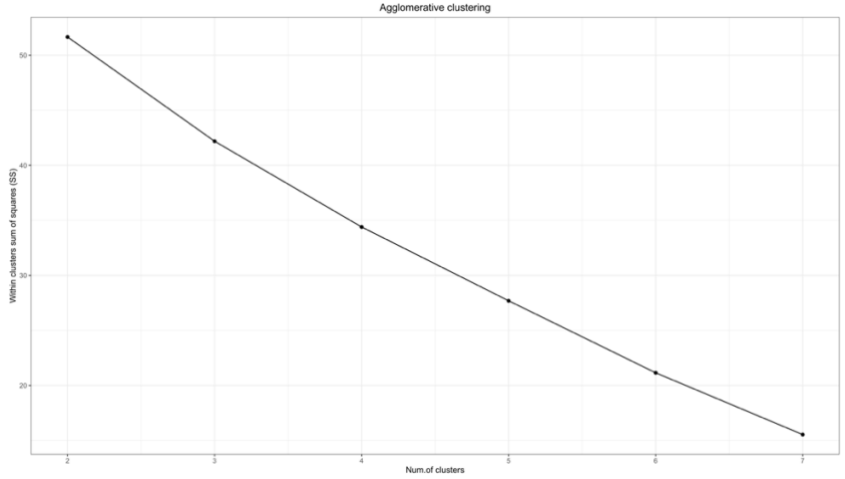
ID	Chronic condition
clbp	Chronic low back pain
cons	Severe constipation
cpai	Chronic pain
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
prio	Chronic periodontitis and gingivitis

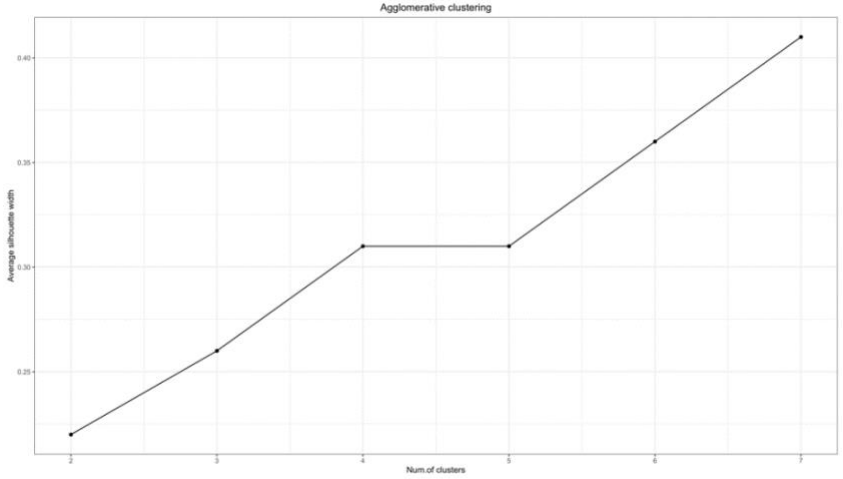
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

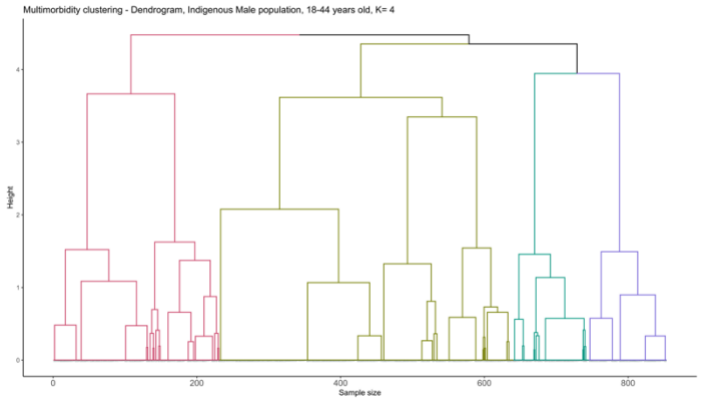


Appendix 42 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 853

The model for k=4 clusters is displayed (Bottom-right) for the indigenous Male population aged 18-44 years old suffering from Chronic conditions whose sex- and age-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom: Dendrogram.

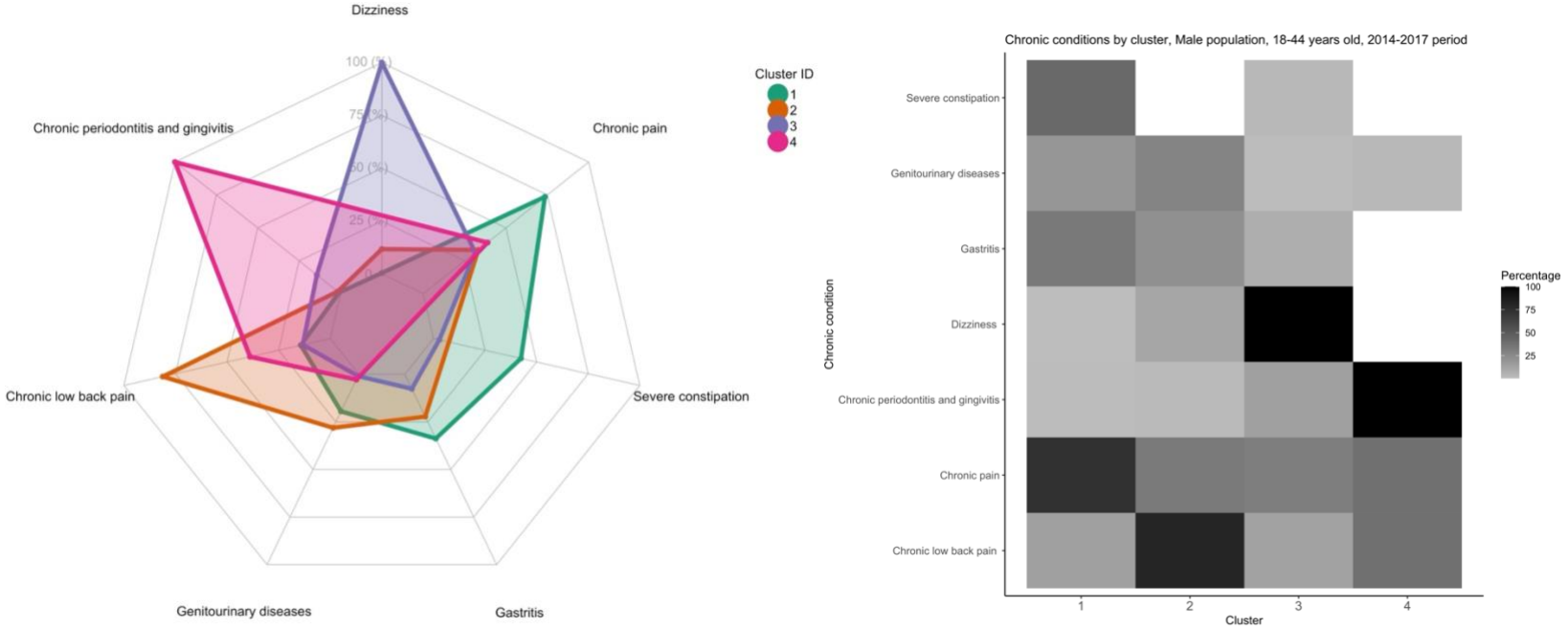






Appendix 43 - Figure. Multimorbidity patterns in the Male indigenous population aged 18-44 (Left), 2014-2017 period, n= 853

Distribution of enrollees by cluster is represented (right)

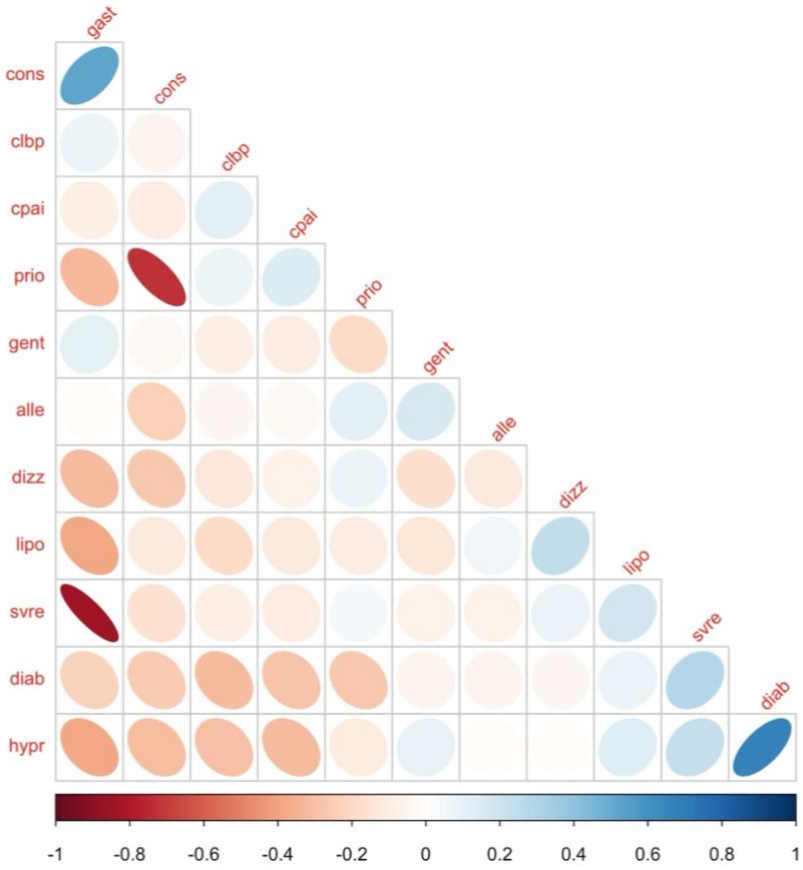


Appendix 44 - Table. Multimorbidity patterns in Indigenous Male population, 45-64 years old, 2014-2017

Chronic conditions with a sex- and age-specific prevalence > 1%

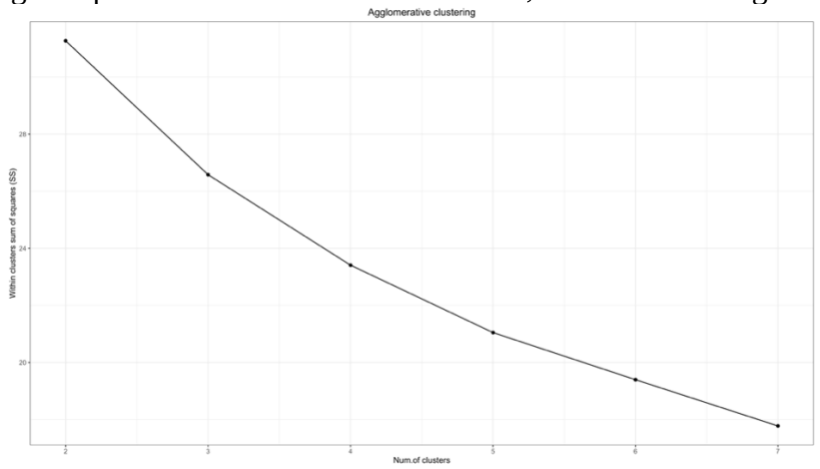
ID	Chronic condition
alle	Allergy
clbp	Chronic low back pain
cons	Severe constipation
cpai	Chronic pain
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
lipo	Disorders of the lipoprotein metabolism
prio	Chronic periodontitis and gingivitis
svre	Severe vision reduction

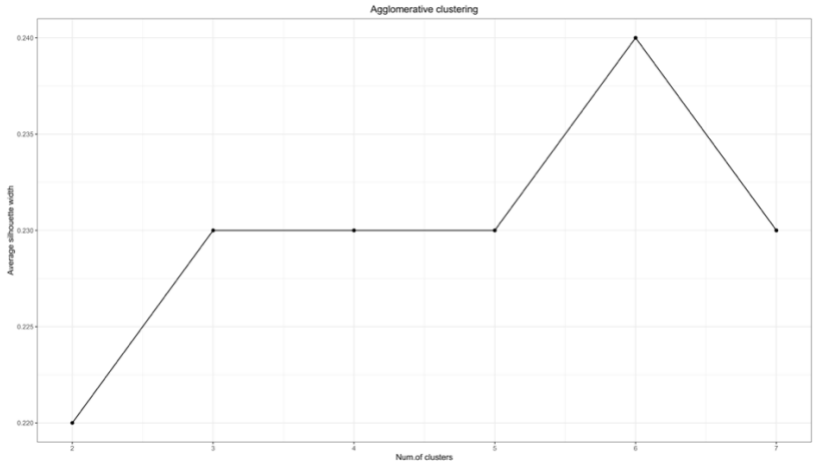
Figure. Polychoric correlations between chronic conditions having a prevalence > 1%

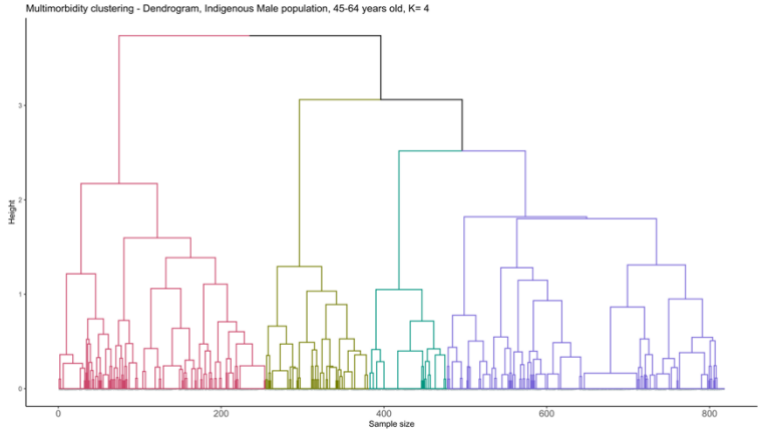


Appendix 45 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 818

The model for k=4 clusters is displayed (Bottom-right) for the indigenous Male population aged 45-64 years old suffering from Chronic conditions whose sex- and age-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom: Dendrogram.

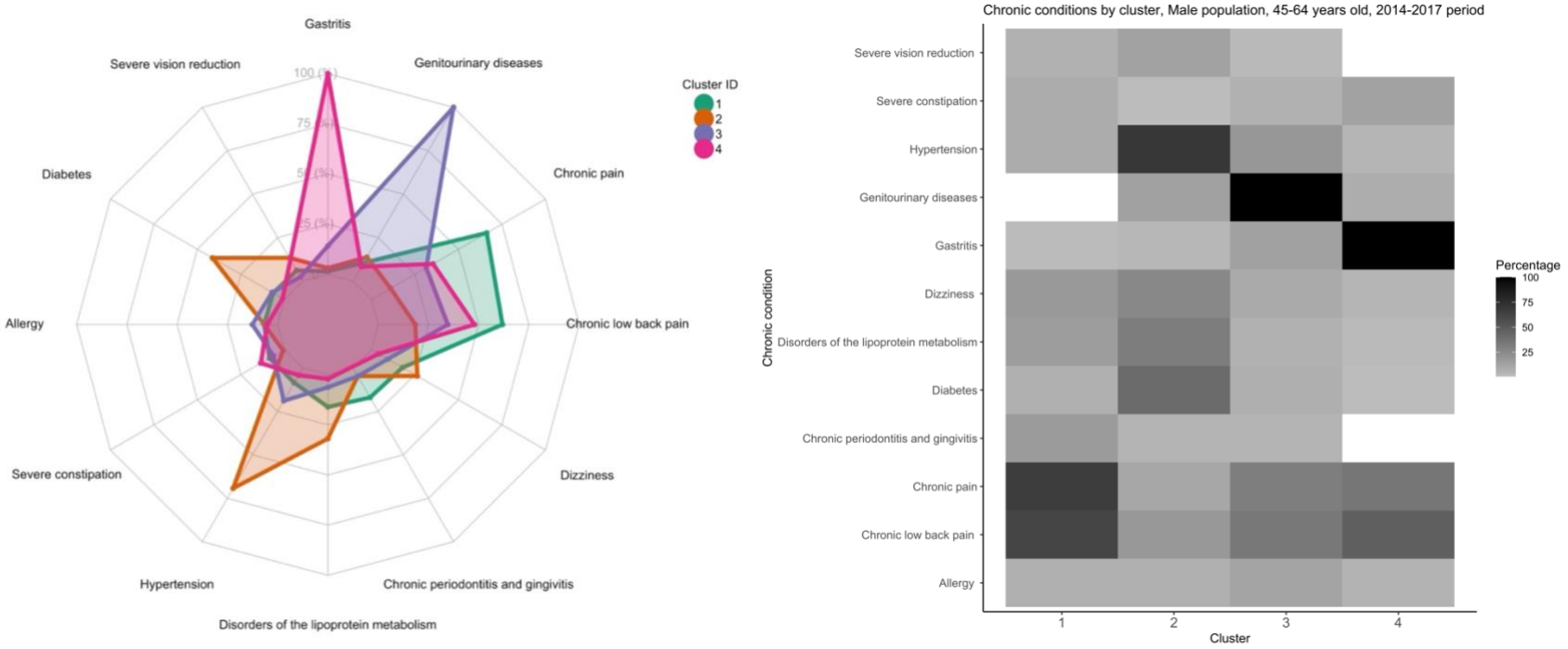






Appendix 46 - Figure. Multimorbidity patterns in the Male indigenous population aged 45-64 (Left), 2014-2017 period, n= 818

Distribution of enrollees by cluster is represented (right)

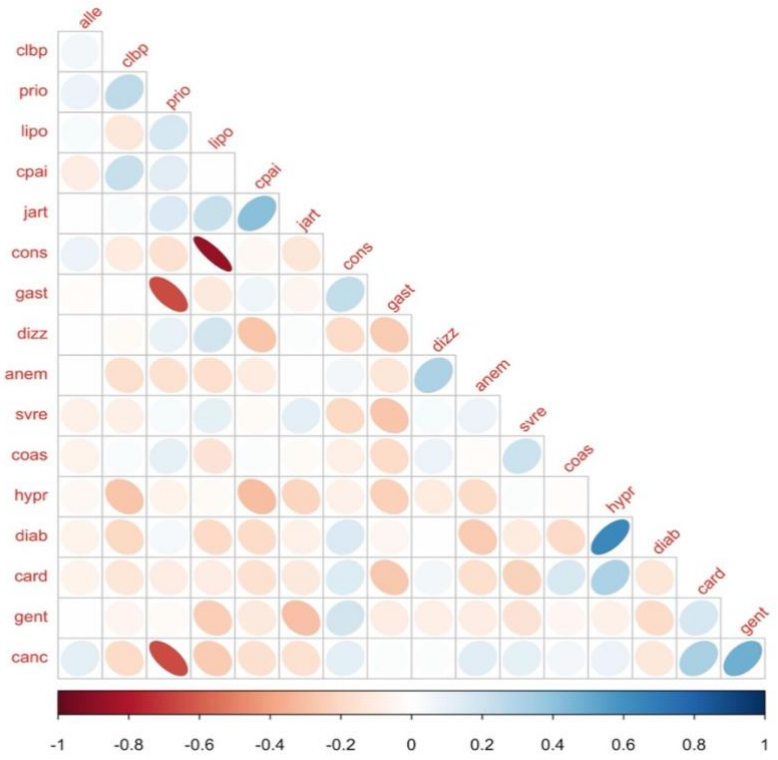


Appendix 47 - Table. Multimorbidity patterns in Indigenous Male population, 65+ years old, 2014-2017

Chronic conditions with a sex- and age-specific prevalence > 1%

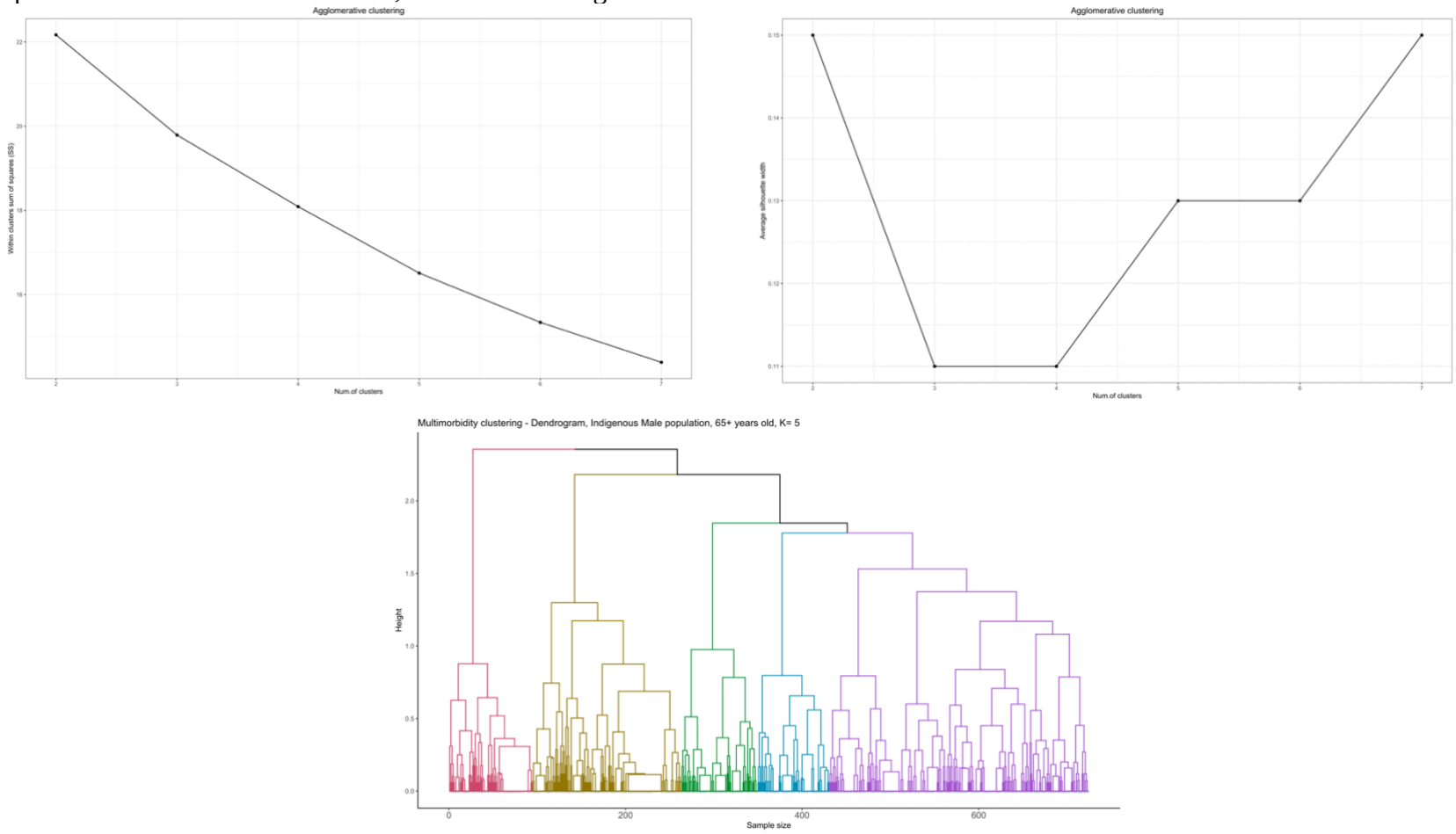
ID	Chronic condition
alle	Allergy
anem	Anemia
canc	Cancer
card	Cardiac disease
clbp	Chronic low back pain
coas	COPD/asthma
cons	Severe constipation
cpai	Chronic pain
diab	Diabetes
dizz	Dizziness
gast	Gastritis
gent	Genitourinary diseases
hypr	Hypertension
jart	Joint arthrosis
lipo	Disorders of the lipoprotein metabolism
prio	Chronic periodontitis and gingivitis
svre	Severe vision reduction

Figure. Polychoric correlations between chronic conditions having a prevalence > 1%



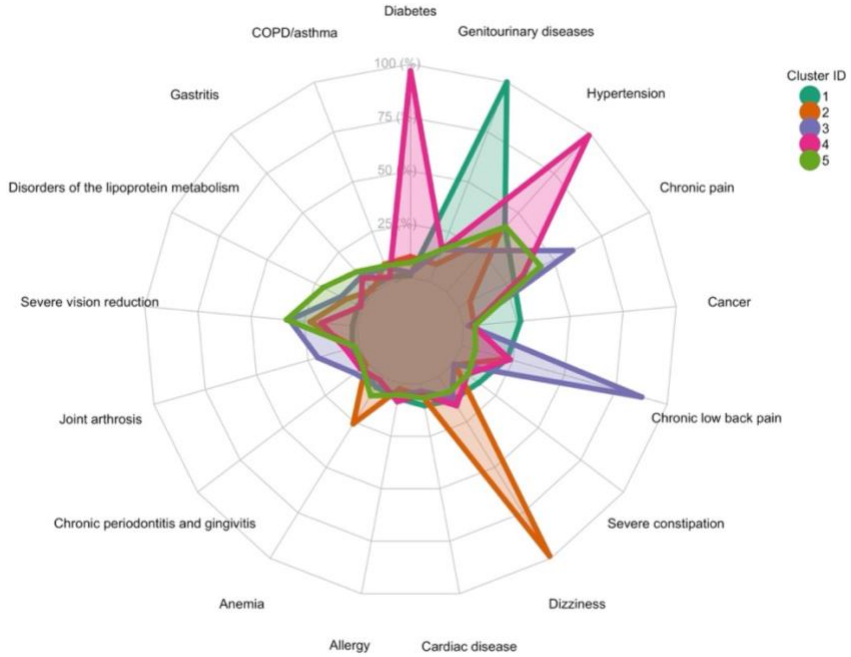
Appendix 48 - Figure. Estimates from Agglomerative Hierarchical Clustering analysis, Ward's Method, n= 724

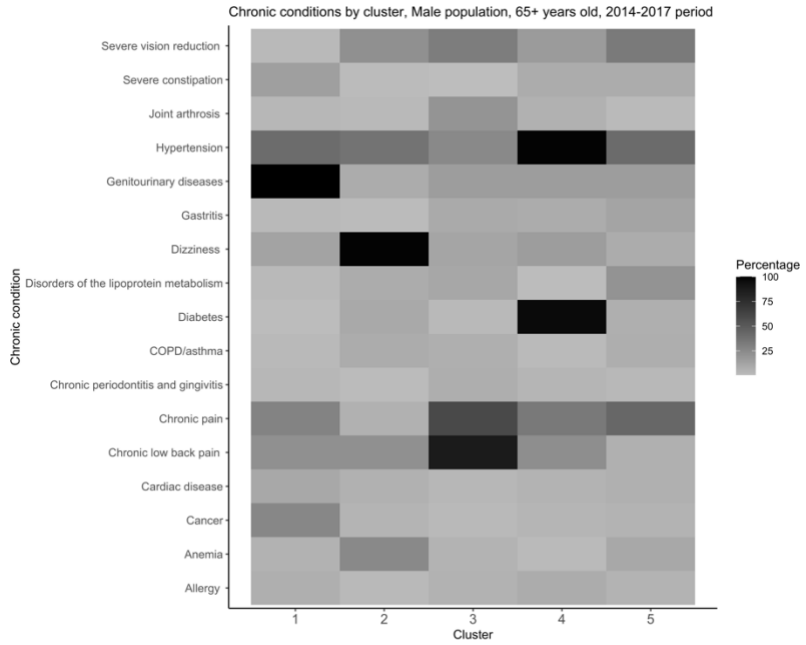
The model for k=5 clusters is displayed (Bottom-right) for the indigenous Male population aged 65+ years old suffering from Chronic conditions whose sex- and age-specific prevalence was >1% in 2014-2017. Top-left: representation of Elbow method; Top-right: representation of Silhouette method; Bottom: Dendrogram.



Appendix 49 - Figure. Multimorbidity patterns in the Male indigenous population aged 65+ years old (Left), 2014-2017 period, n= 724.

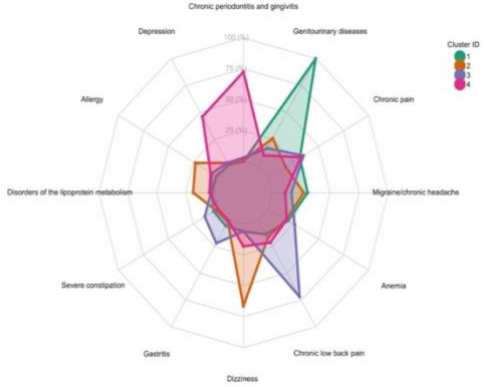
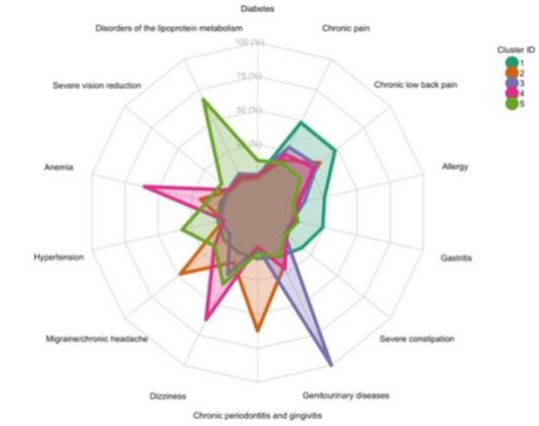
Distribution of enrollees by cluster is represented (right)





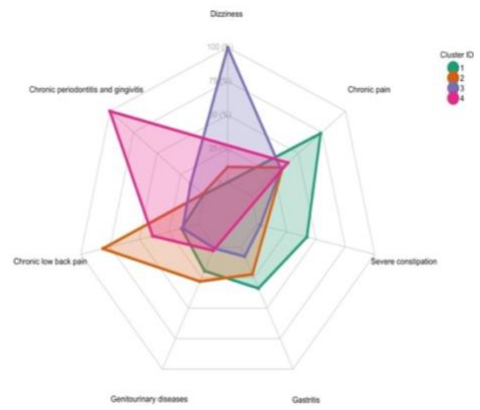
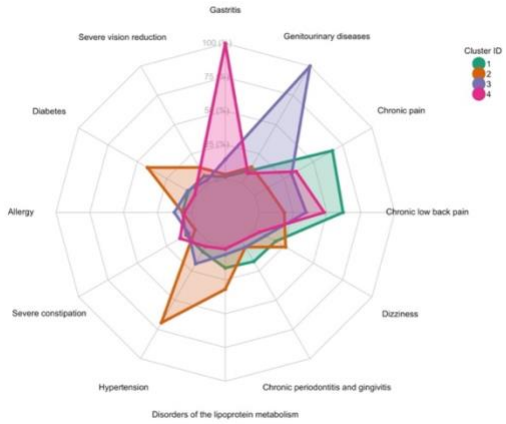
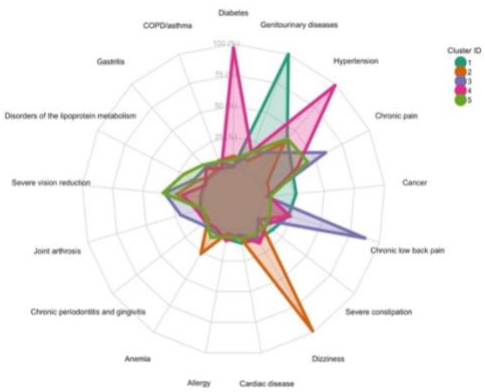
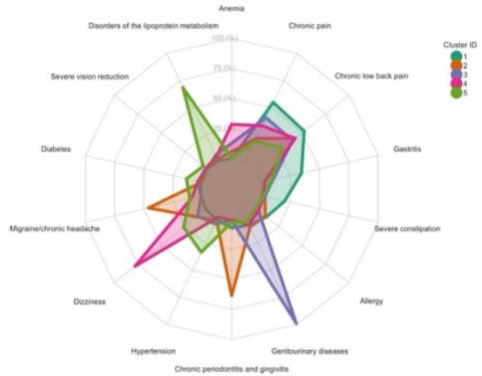
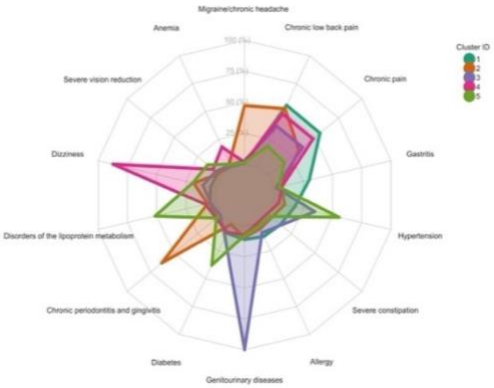
Appendix 50 - Table. Summary: estimates from HCA, Female population, Ward's Method

Representation of age-specific HCA models (Top), and the distribution of HCA for the total population by the Females population's age groups (Bottom)

	18-44 years old	45-64 years old	65+ years old
Stratified HCA			
Distribution of HCA for total population			

Appendix 51 - Table. Summary: estimates from HCA, Male population, Ward's Method

Representation of age-specific HCA models (Top), and the distribution of HCA for the total population by the Male population's age groups (Bottom)

	18-44 years old	**45-64 years old**	**65+ years old**
Stratified HCA			
Distribution of HCA for total population			

Appendix 52 - Table. Distribution of study outcome: Total number of healthcare services used by semester among patients suffering from chronic conditions

Patient group	Summary	January to June 2018	July to December 2018	January to June 2019	July to December 2019
Cluster 1/A (n=2849), Dead/Left in 2014-2017: n=114 (3.8%)	Total claims	2712	3153	2477	2563
	Dead/Left AW [n (%)]	-	59 (2.1)	106 (3.7)	202 (7.1)
	Mean claims (SD)	1 (3.39)	1.1 (4.16)	0.9 (3.56)	1 (4.11)
	Maximum claims	58	87	37	86
	Zero values [n (%)]	2302 (80.8)	2240 (78.6)	2261 (79.4)	2189 (76.8)
Cluster 2/B (n=1409), Dead/Left AW in 2014-2017: n=42 (2.9%)	Total claims	625	695	591	455
	Dead/Left AW [n (%)]	-	11 (0.8)	30 (2.1)	54 (3.8)
	Mean claims (SD)	0.4 (1.7)	0.5 (2.69)	0.4 (2.34)	0.3 (1.76)
	Maximum claims	20	67	50	40
	Zero values [n (%)]	1177 (83.5)	1173 (83.3)	1191 (84.5)	1187 (84.2)
Cluster 3/C (n=1142), Dead/Left AW in 2014-2017: n=62 (5.1%)	Total claims	2480	2557	2079	1841
	Dead/Left AW [n (%)]	-	27 (2.4)	45 (3.9)	77 (6.7)
	Mean claims (SD)	2.2 (6.64)	2.3 (8.05)	1.9 (11.23)	1.7 (6.33)
	Maximum claims	127	199	334	104
	Zero values [n (%)]	803 (70.3)	803 (70.3)	801 (70.1)	811 (71)
Cluster 4/D (n=1382), Dead/Left AW in 2014-2017: n=60 (4.2%)	Total claims	1137	1099	856	742
	Dead/Left AW [n (%)]	-	23 (1.7)	49 (3.5)	78 (5.6)
	Mean claims (SD)	0.8 (3.24)	0.8 (3.96)	0.6 (3.13)	0.6 (2.71)
	Maximum claims	40	53	40	36
	Zero values [n (%)]	1150 (83.2)	1146 (82.9)	1148 (83.1)	1128 (81.6)
Cluster 5/E (n=1511), Dead/Left AW in 2014-2017: n=101 (6.3%)	Total claims	5031	4894	4151	3642
	Dead/Left AW [n (%)]	-	31 (2.1)	62 (4.1)	98 (6.5)
	Mean claims (SD)	3.3 (9.37)	3.3 (6.87)	2.9 (9.6)	2.6 (7.21)
	Maximum claims	260	96	266	78
	Zero values [n (%)]	886 (58.6)	868 (57.4)	895 (59.2)	967 (64)
One chronic condition (n=10578), Dead/Left	Total claims	2742	2674	2202	2097
	Dead/Left AW [n (%)]	-	260 (2.5)	495 (4.7)	892 (8.4)

Patient group	Summary	January to June 2018	July to December 2018	January to June 2019	July to December 2019
AW in 2014-2017: n=596 (5.3%)	Mean claims (SD)	0.3 (1.98)	0.3 (1.99)	0.2 (1.81)	0.2 (1.86)
	Maximum claims	63	76	61	45
	Zero values [n (%)]	10006 (94.6)	9760 (92.3)	9594 (90.7)	9238 (87.3)
Other multimorbidity* (n=86), Dead/Left AW in 2014-2017: n=18 (17.3%)	Total claims	439	317	130	177
	Dead/Left AW [n (%)]	-	3 (3.5)	7 (8.1)	13 (15.1)
	Mean claims (SD)	5.1 (22.99)	3.8 (11.5)	1.6 (4.94)	2.4 (8.15)
	Maximum claims	207	85	24	48
	Zero values [n (%)]	67 (77.9)	63 (73.3)	62 (72.1)	56 65.1)

*Patients with chronic conditions with period prevalence <=1% excluded from HCA. AW: Anas Wayuu; SD: Standard deviation

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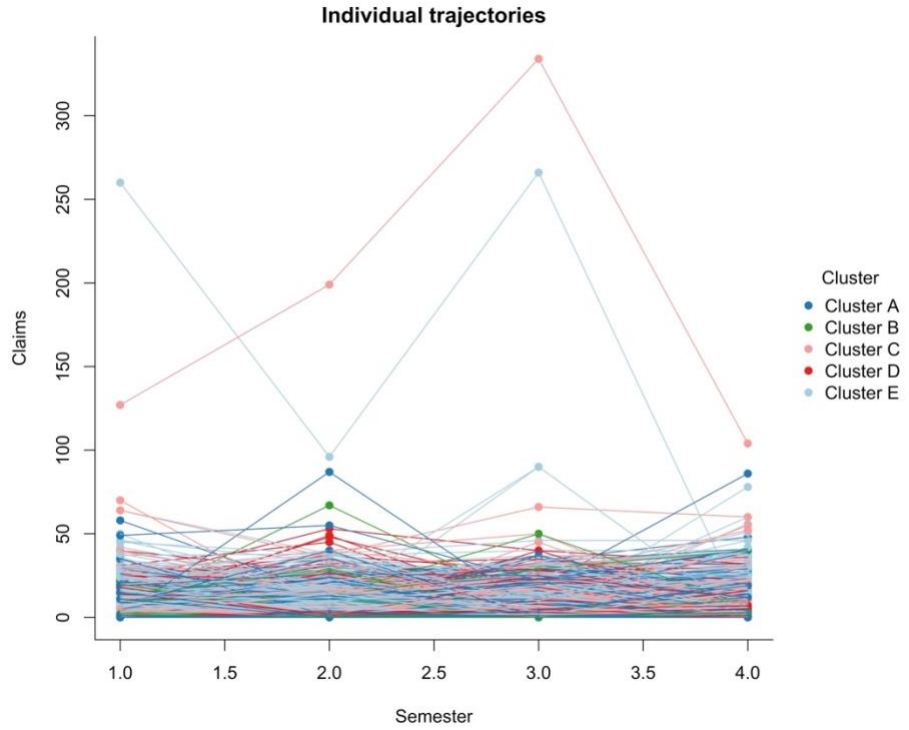
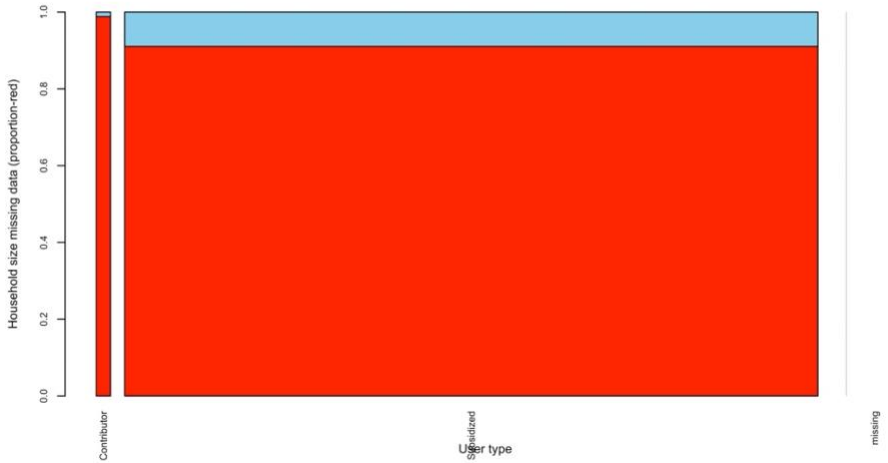
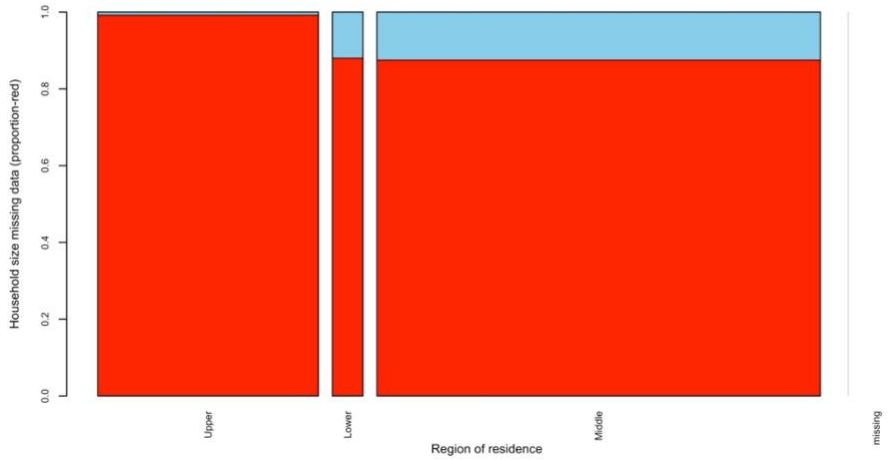
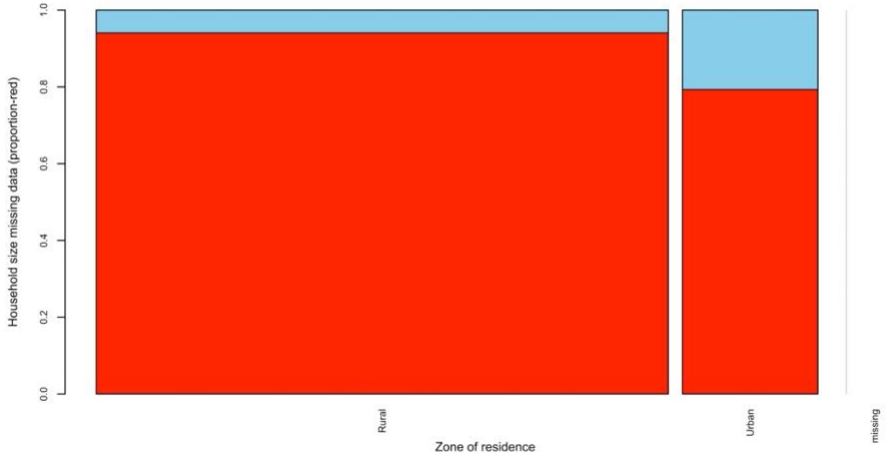
Appendix 53 - Figure. Distribution of outcome and individual growth trajectories. Outcome: Total number of healthcare services provided by semester, 2018-2019. Outcome level of measurement: discrete (count). Time variable: four periods, 6-month intervals, total Indigenous population

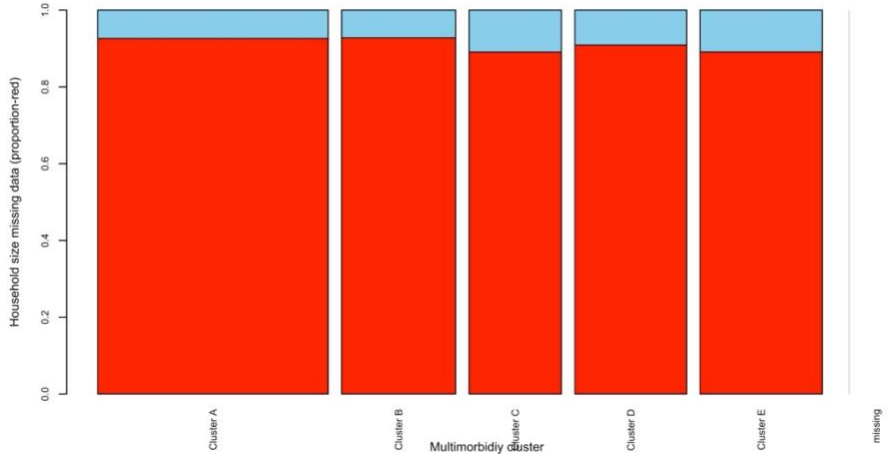


Appendix 54 - Figure. Representation of missingness mechanism (Missing not at random) of Household size by comparing it against available covariates, total Indigenous population

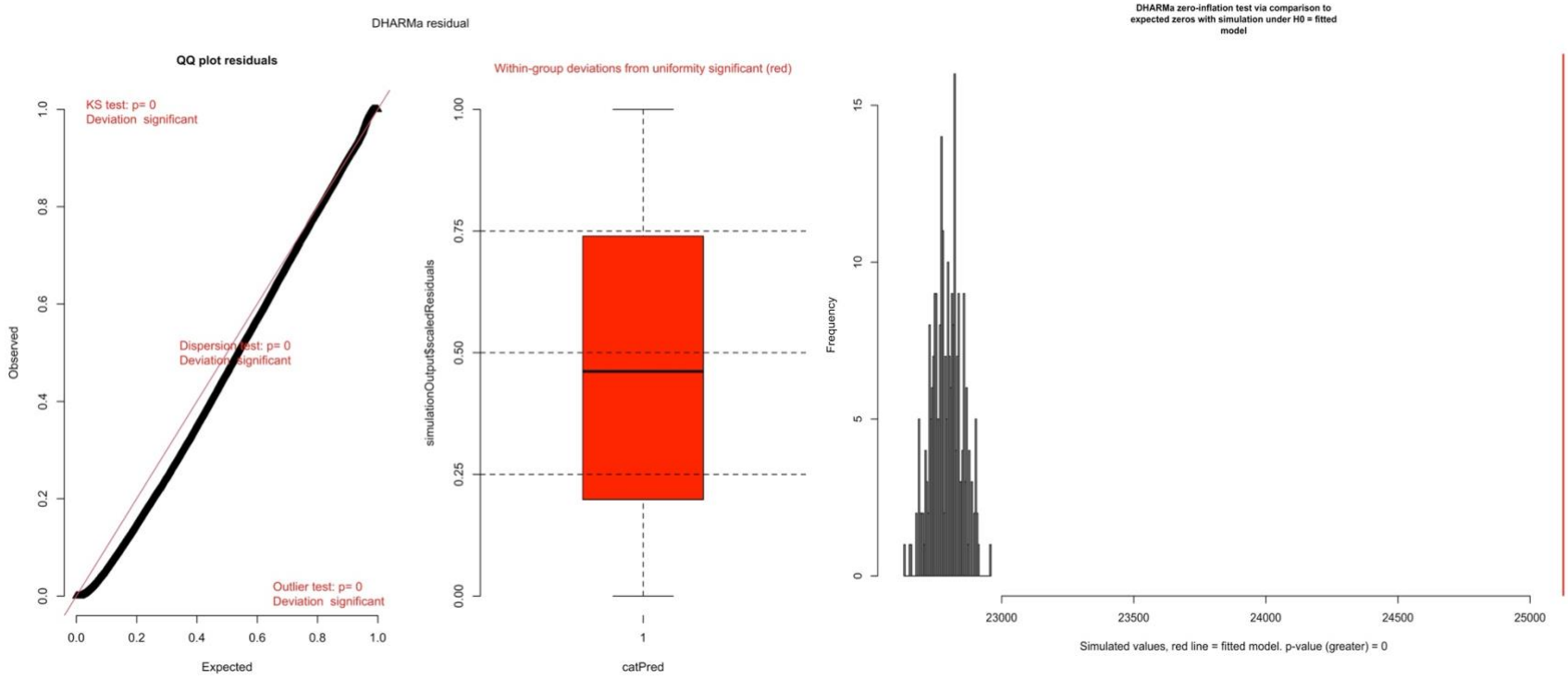








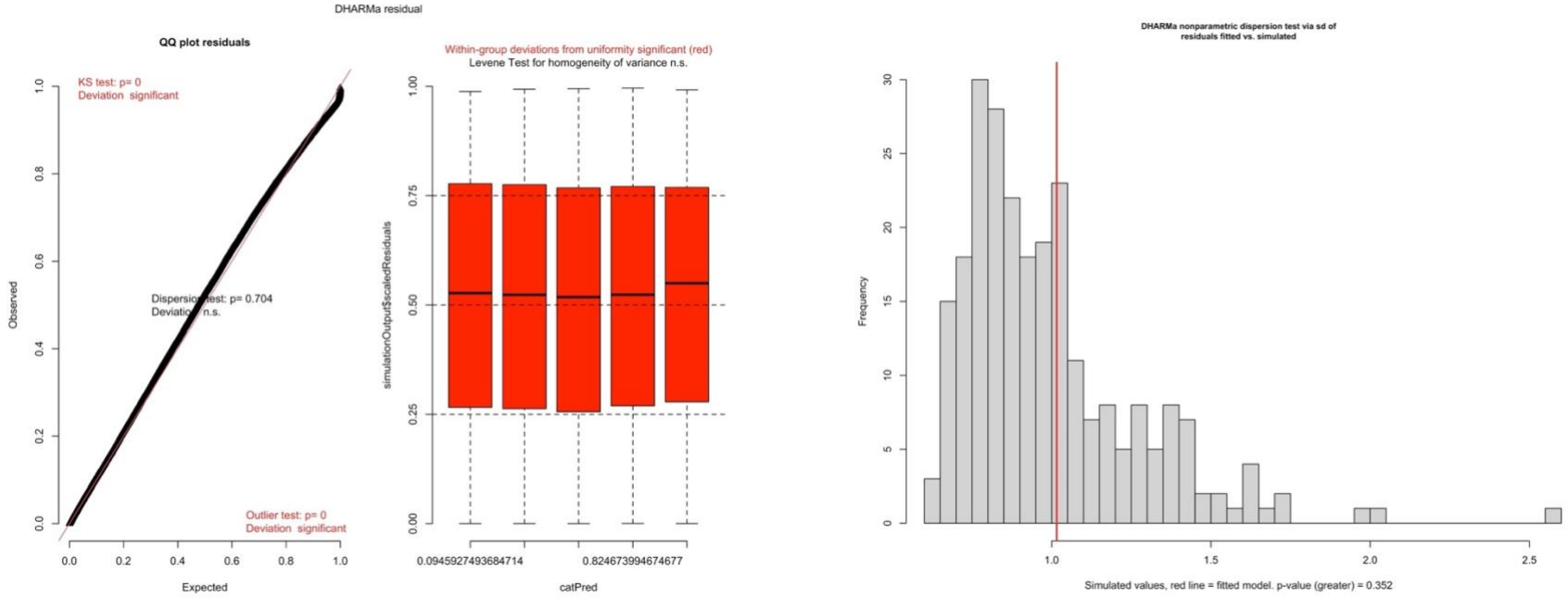
Appendix 55 - Figure. Residual diagnostics for regression models to identify the mixed model technique to be used for modelling study outcome, total Indigenous population



Residual patterns of overdispersion: Poisson mixed model. This model does not fit the data well because of the presence of over-dispersion and the extra zeros

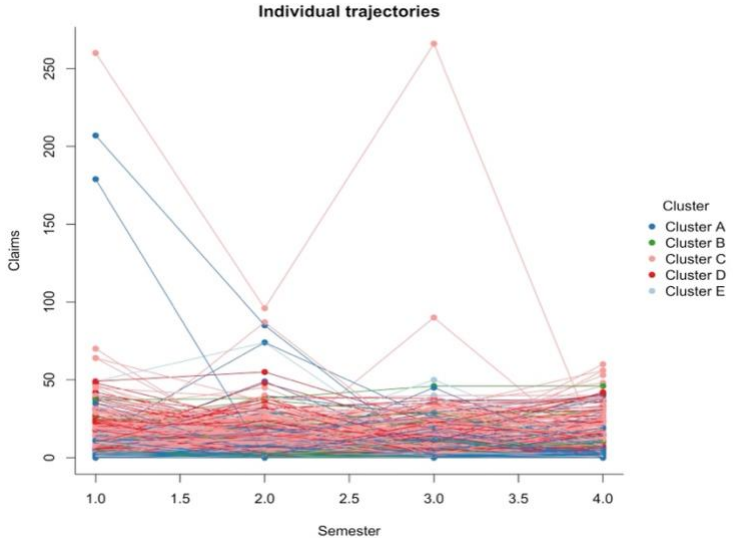
Residual patterns of overdispersion: Zero-inflated Poisson mixed model with extra random effects including cluster covariate.

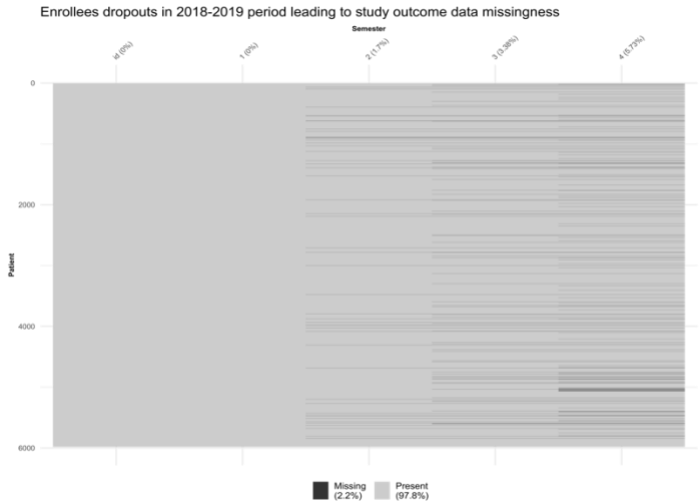
Figure (cont.). Residual diagnostics for regression models to identify the mixed model technique to be used for modelling study outcome, *total Indigenous population*



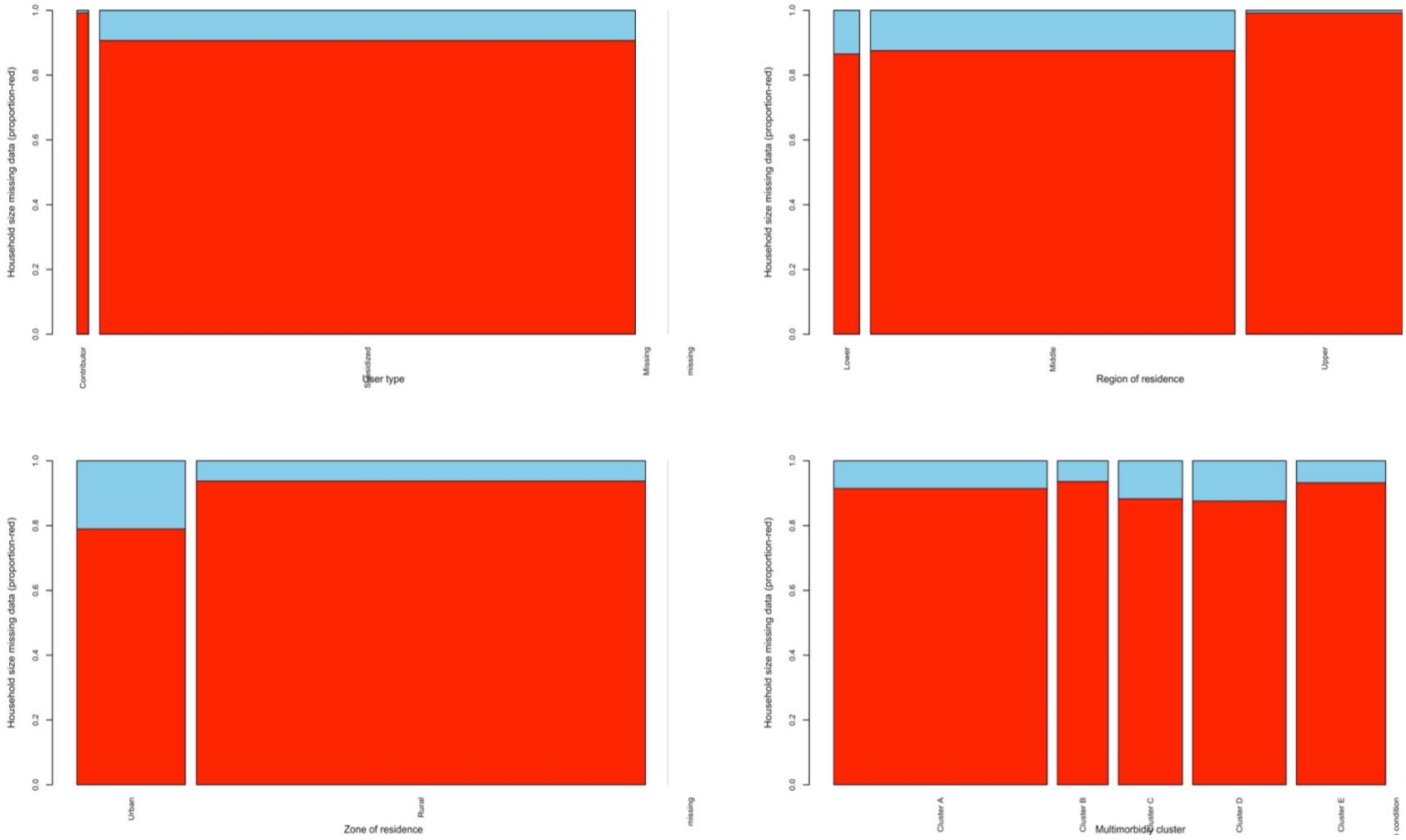
Residual patterns of overdispersion: the Zero-Inflated Negative Binomial Mixed Model with Extra Random Effects appears acceptable to model overdispersion (left panel, p-value=0.704), and zero-inflated outcome (right panel, p-value=0.352), but heteroscedasticity is present. Thus, the study outcome is modelled using a Zero-Inflated Negative Binomial Mixed Model with Extra Random effects.

Appendix 56 - Figure. Distribution of outcome and individual growth trajectories. Outcome: Total number of healthcare services provided by semester, 2018-2019. Outcome level of measurement: discrete (count). Time variable: four periods, 6-month intervals, Female Indigenous population

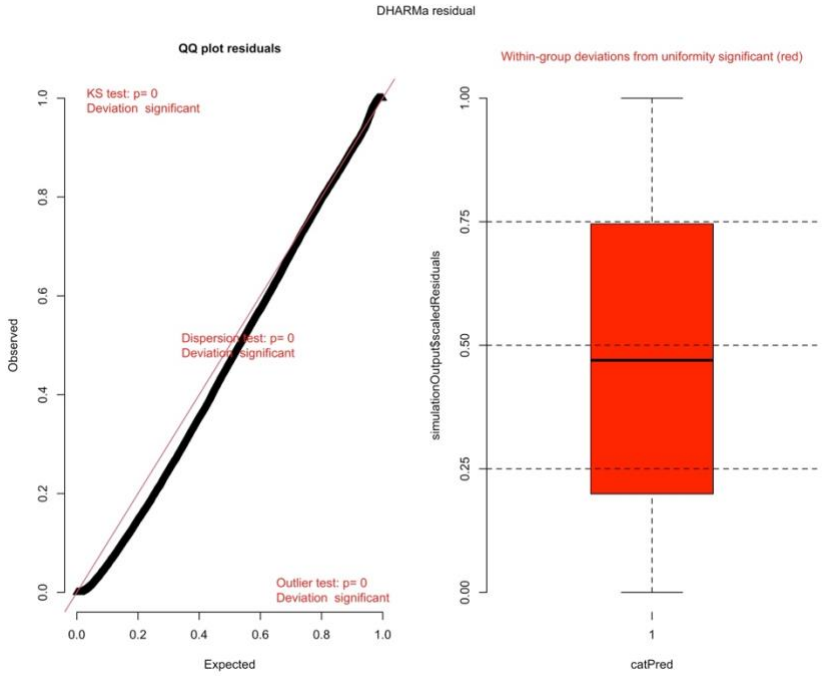




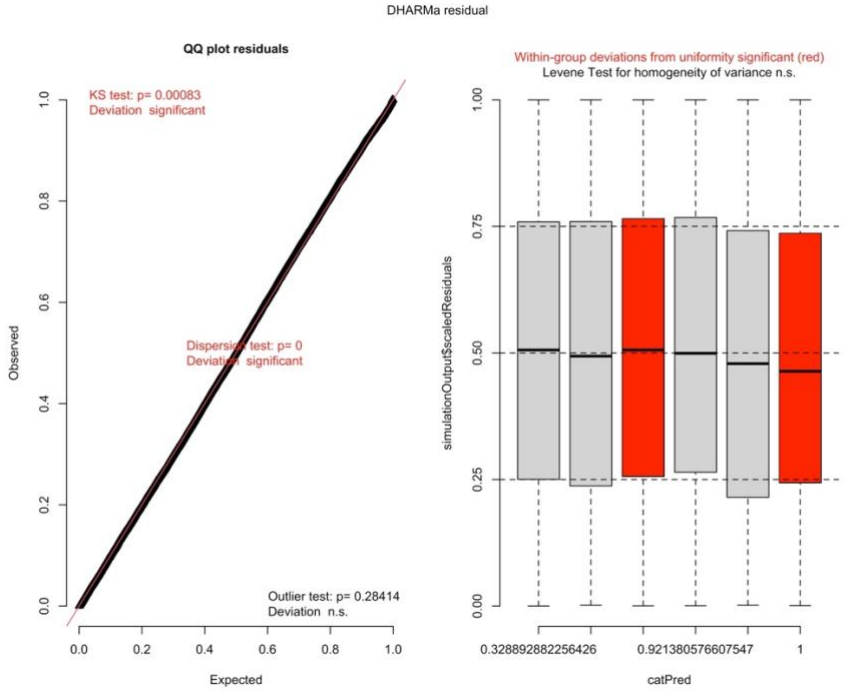
Appendix 57 - Figure. Representation of missingness mechanism (Missing not at random) of Household size by comparing it against available covariates, Female Indigenous population



Appendix 58 - Figure. Residual diagnostics for regression models to identify the mixed model technique to be used for modelling study outcome, Female indigenous population

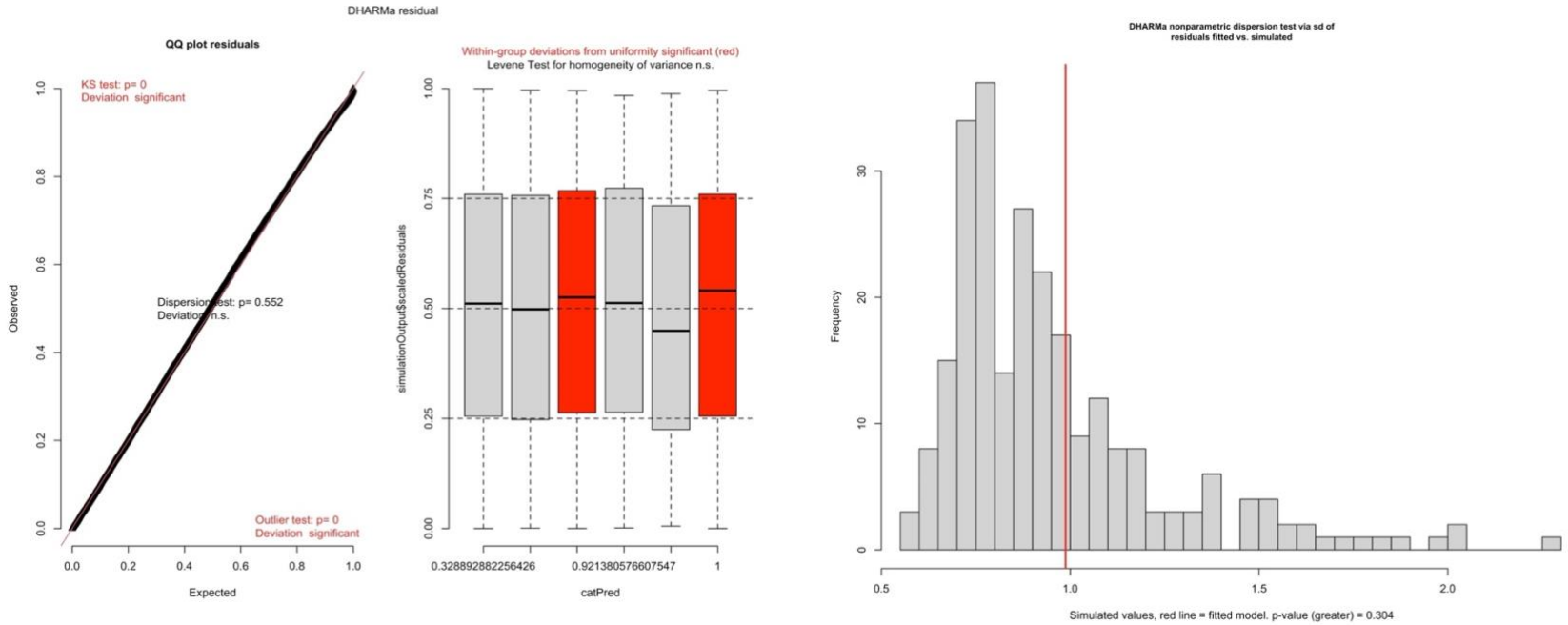


Residual patterns of overdispersion: Poisson mixed model. This model does not fit the data well because of the presence of over-dispersion and the extra zeros



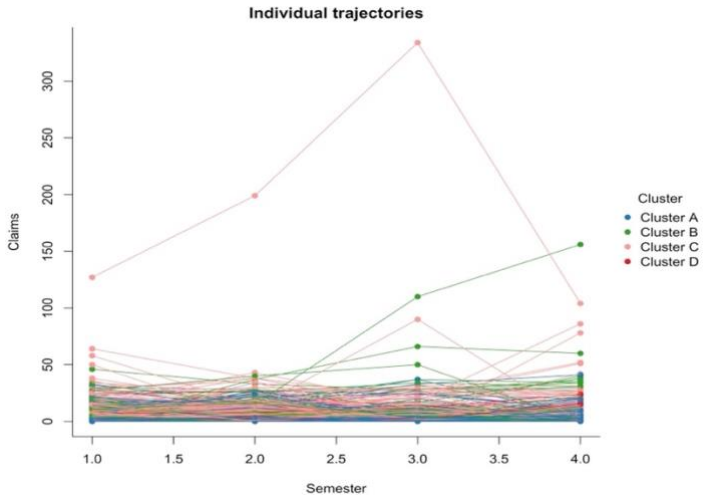
Residual patterns of overdispersion: Zero-inflated Poisson mixed model with extra random effects including cluster covariate. Overdispersion and Heteroscedasticity are observed as potential systematic dependency of the dispersion/variance on cluster variable

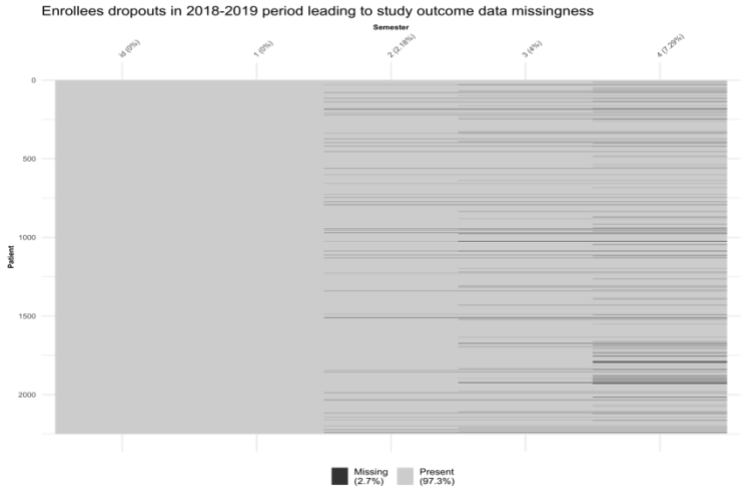
Figure (cont.). Residual diagnostics for regression models to identify the mixed model technique to be used for modelling study outcome, Female Indigenous Population



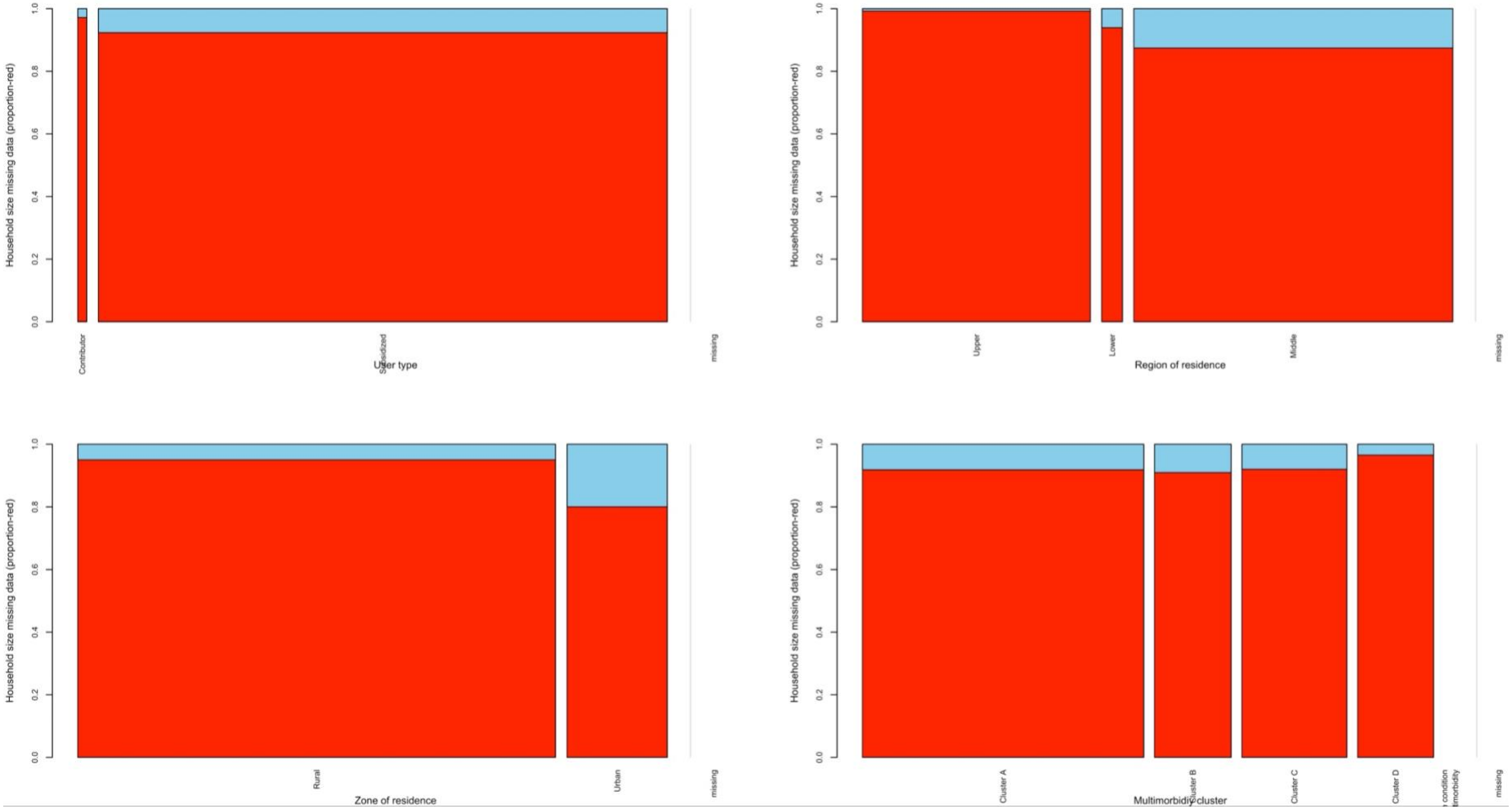
Residual patterns of overdispersion: the Zero-Inflated Negative Binomial Mixed Model with Extra Random Effects appears acceptable to model overdispersion (left panel, p-value=0.552), and zero-inflated outcome (right panel, p-value=0.304), but heteroscedasticity is present. Thus, the study outcome is modelled using a Zero-Inflated Negative Binomial Mixed Model with Extra Random effects.

Appendix 59 - Figure. Distribution of outcome and individual growth trajectories. Outcome: Total number of healthcare services provided by semester, 2018-2019. Outcome level of measurement: discrete (count). Time variable: four periods, 6-month intervals, Male Indigenous population

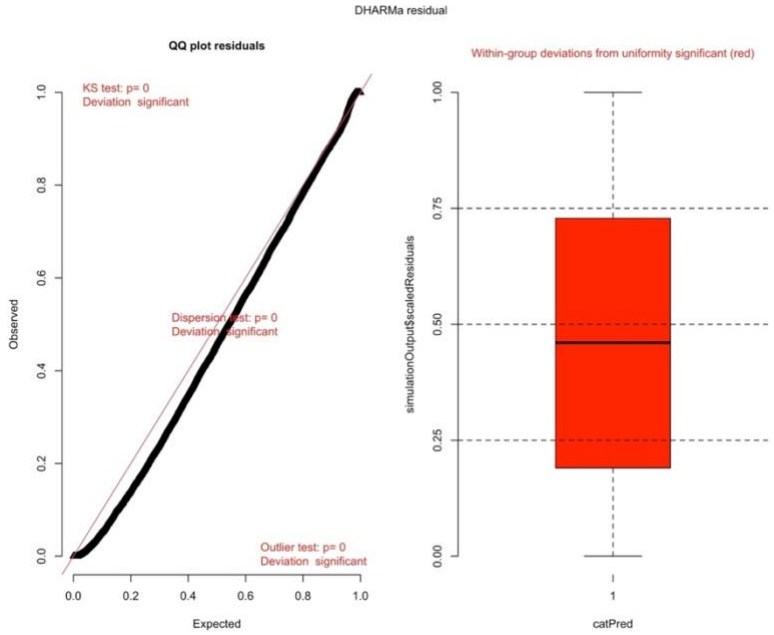




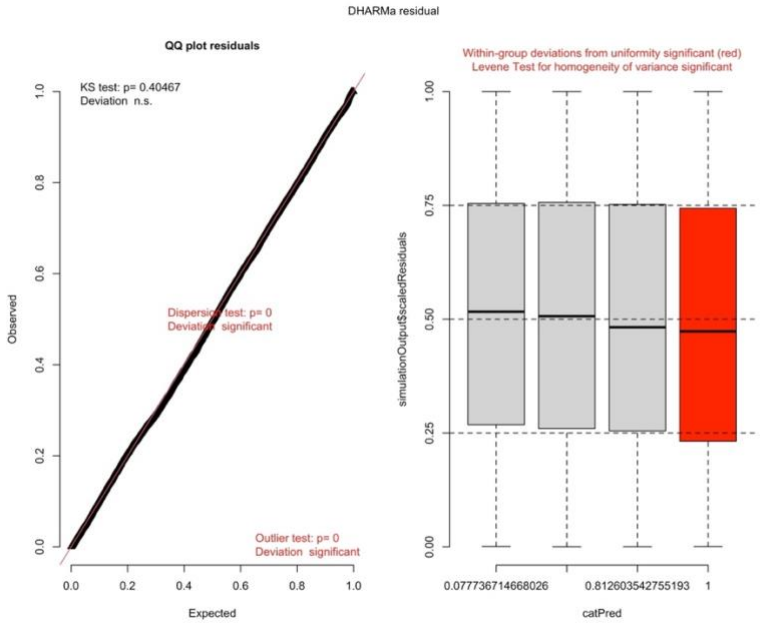
Appendix 60 - Figure. Representation of missingness mechanism (Missing not at random) of Household size by comparing it against available covariates, Male Indigenous population



Appendix 61 - Figure. Residual diagnostics for regression models to identify the mixed model technique to be used for modelling study outcome, Male Indigenous population

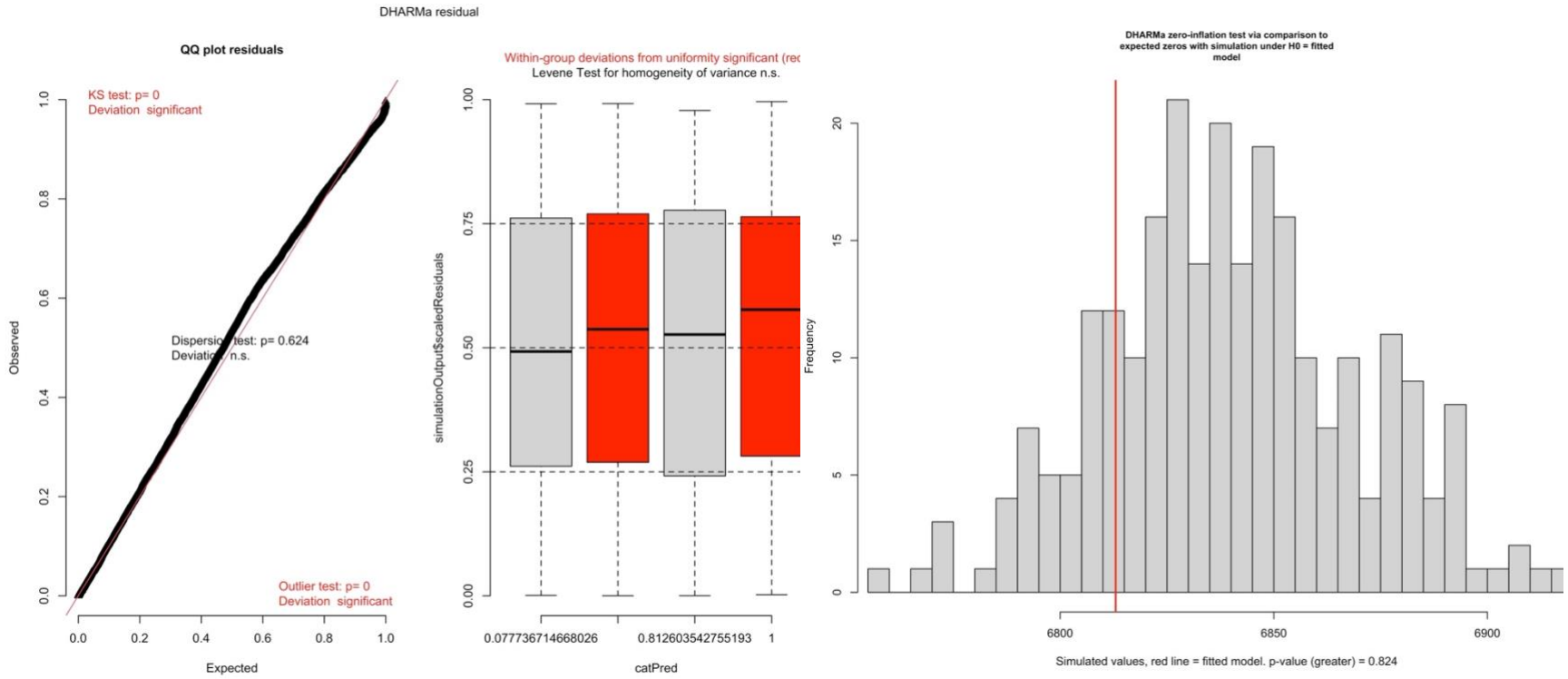


Residual patterns of overdispersion: Poisson mixed model. This model does not fit the data well because of the presence of over-dispersion and the extra zeros



Residual patterns of overdispersion: Zero-inflated Poisson mixed model with extra random effects including cluster covariate. Overdispersion and Heteroscedasticity are observed as potential systematic dependency of the dispersion/variance on cluster variable

Figure (cont.). Residual diagnostics for regression models to identify the mixed model technique to be used for modelling study outcome, Male Indigenous population.



Residual patterns of overdispersion: the Zero-Inflated Negative Binomial Mixed Model with Extra Random Effects appears acceptable to model overdispersion (left panel, p-value=0.624), and zero-inflated outcome (right panel, p-value=0.824), but heteroscedasticity is present. Thus, the study outcome is modelled using a Zero-Inflated Negative Binomial Mixed Model with Extra Random effects.

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