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Age in Impacting the Occurrence of Chronic Diseases: Case of Recurrently Diagnosed Diseases at Korhogo Regional Hospital in Northern of Cote d'Ivoire

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Abstract: *Background:* Our previous study suggested Korhogo district as strongly influenced by parasitical and infectious diseases and as well high blood pressure (HBP) troubles. In the same study, we shown that recurrently diagnosed diseases at Korhogo Regional Hospital (KRH) clustered in two group, depending on the regular and/or irregular dynamism of their increasing. Diseases with regular increasing dynamism (i.e. hypertension) claiming to be chronic diseases were controlled by patients' anthropomorphic parameters such as age and weight as opposite to diseases with irregular increasing frequency dynamism dominated by malaria and influenza (infectious and tropical diseases). Basing on these results, we embarked here in assessing the relationship between age anthropomorphic parameter and the occurrence of recurrently diagnosed diseases at KRH. *Methods:* Patients clinical and anthropomorphic parameters data (i.e. age and weight), collected from 2014 to 2018 at the general medicine division of KRH, were subsequently structured and submitted to a multivariate computational statistical analysis in R programming environment. *Results:* Our findings showed the strong influence of aging on the occurrence of all recurrent listed and analyzed pathologies recorded at KRH from 2014 to 2018 and in particular, on chronic diseases such as cardiovascular troubles dominated by high blood pressure (HBP), osteo-articular/muscular, metabolic diseases (diabetes) and digestive troubles. *Conclusion:* Considering as a whole, even if our study supported a high concordance between aging and occurrence of diseases recurrently recorded at KRH, it is noteworthy to underline the significant correlation between aging (age increasing) and chronic diseases occurrence. This trend results accentuated for chronic diseases, i.e. high blood pressure, osteo-articular and muscular diseases for age over 50 years.

Keywords: Recurrently Diagnosed Diseases, Chronic Diseases, Korhogo Regional Hospital (KRH), Aging, Multivariate Analysis, R Fitting Curve

1. Introduction

Chronic illnesses and/or diseases are generally defined as conditions necessitating continuing medical assistance for a long period, influencing and limiting normal daily living activities. Chronic disease; i.e. heat diseases, cancer and diabetes are the principal causes of death and infirmity in the most advanced and/or developed country. Of note, among the 36 million people who died because of chronic diseases in 2008, 29% were under the age 60. In Africa, these diseases exhibit a gradual increase in the evolution of their epidemiology. Chronic diseases affected approximately 27 to 28% of the adult population with age ≥ 20 years in sub-Saharan-Africa [1]. Even if health progress currently concerns the entire planet, inequalities in health issues remain or even worsen. Southern countries, in particular those in sub-Saharan Africa at the last century (20 century) exhibited a slow rate of increase in life expectancy than the countries of North. For some them, mortality has even recovered increase, often dramatically, as a result of the AIDS epidemic. Of note, the drop in mortality continued in the developed countries thanks to the control of chronic diseases. In Sothern countries, and especially in Africa, despite successes in the fight against infectious diseases and in particular tropical diseases, such as malaria, the outbreak of AIDS and wrong hygiene in the living communities have led to a shape collapse in life expectancy. Thus, in most countries of sub-Saharan Africa, chronic diseases are added to the infectious diseases and the seriousness of the rapid emergence of chronic diseases mean that the health situation, aggravated by the COVID-19 pandemic, is increasingly worrying. Our previous studies suggested malaria and hypertension as key raisons of patient's consultation at Korhogo Regional Hospital (KRH) in Northern Cote d'Ivoire a sub-Saharan-Africa country from 2014 to 2018 [2]. The same investigations exhibited an increasing of colopathy, lombosciatic, pneumonia, osteoarthritis and ulcer, gastroenteritis cardiac cases as well metabolic troubles at KGH from 2014 to 2018. Taking together infectious and tropical diseases (malaria) as well as chronic troubles result to be health concern in Korhogo locality in Northern Cote d'Ivoire. Mainly infectious and chronic diseases increasing is clearer in sub-Saharan Africa countries [3, 4]. Excellent medical care combined to good living conditions in advanced countries have increased both health and life expectancy, from around 50 years in the early 1900s to over 80 now. However, age remains the main risk factor with regard debilitating and as well life-threatening disorders, including chronic diseases; i.e. cancer, cardiovascular disease and neurodegeneration [5], all of which are therefore increasing in prevalence [5, 6]. Of note, numerous studies supported anthropomorphic parameters such as age and weight as influencing tropical and as well chronic diseases cases increasing [1, 7-9]. In addition, all risk factor associated to chronic diseases result to be implicate in inflammation up-regulation. Therefore, inflammation-associated risk factor gene expression downregulation could interfere with age-associated diseases [7, 10]. Age is the main risk factor for the prevalent diseases of developed and as well developing countries (i.e. cancer, cardiovascular disease and neurodegeneration) [5]. The ageing progression is damaging for fitness, but can nonetheless evolve because of the declining force of natural selection at later ages, attributable to extrinsic hazards to survival. Getting old can be attributable to the effect of accumulation of mutations that lower fitness at later ages, or of natural selection in favor of mutations that increase fitness of the young but at the cost of a higher subsequent rate of ageing [8]. Noel et al. (2022) [2] shown that a multitude exogenous and endogenous factors could influenced diseases recrudescence in Korhogo Northern of Cote d'Ivoire. Indeed, study assessing non-infectious disease that is, high blood pressure troubles contributing in cardiovascular diseases exhibit ageing as a reasonable feature contributing to hypertension occurrence in Korhogo, Northern of Cote d'Ivoire [9, 11, 12]. Of course, it is noteworthy to underline that several exogenous factors can contribute to hypertension ascension. However, since it is well-known that disease phenomena increase progressively with old getting, we discuss here the relationship between patients age increasing and recurrently diagnosed diseases frequency at Korhogo Regional Hospital that include both parasitical and infectious diseases as well as chronic pathologies for a period of five consecutive years (from 2014 to 2018). To do that we collected patient's anthropomorphic and clinical data. Successively collected data were organized and structured by age interval class by Yules and Sturge methods and then submitted to a multivariate computational statistical survey.

2. Material and Methods

2.1. Sampling

We collected clinical (the doctor's diagnosis) and anthropomorphic (age and weight) data for five consecutive years (2014, 2015, 2016, 2017 and 2018) at Korhogo Regional Hospital (KRH) including 1707 patients. Clinical data (retained diagnostic) for the study period involved 25 diseases associated to the sampling at the general medicine division of KGH. Recorded diseases are as following: malaria, AIDS, tuberculosis, varicella, hepatitis, herpes, influenza, gastroenteritis, shingles, hypertension, cardiac pathology, diabetes, lumbosciatic, back pain, osteoarthritis, pneumonia, bronchitis, rhinitis, sinusitis, asthma, gastrointestinal, ulcer, colopathy, gastritis and hemorrhoid according to Noel et al. (2022) [2]. Basing on our previous study [12], we clustered above-mentioned diseaes as following:

i). infectious and parasitic disease (i.e. malaria, AIDS, tuberculosis, varicella, hepatitis, herpes, influenza, gastroenteritis and shingles);
ii). cardiovascular diseases (i.e. hypertension and cardiac pathology);
iii). metabolic and endocrine diseases (diabetes);
iv). muscular and osteoarthritis diseases (lumbosciatic, back pain and osteoarthritis);
v). respiratory diseases (pneumonia, bronchitis, rhinitis, sinusitis and asthma) and
vi). digestive diseases (ulcer, colopathy, gastritis and hemorrhoid).

We reported and considered sampling patient's anthropomorphic parameters; i.e. (i) gender and (ii) age for the subjacent multivariate statistical survey. For this purpose, we organized and structured age anthropomorphic parameter in class intervals by applying Yule [13, 14] and Sturges [14, 15]. formula as following:

i). Sturges: $k = 1 + \log_2 N$; were k represents the number of obtained age class interval, N refers to sampling size and log2 is the base 2 logarithm;

ii). Yule: $k=2.5*(N)^{1/4;}$ were k represents the number of the obtained age class interval, N is for sampling size.

Next, we adjusted class intervals by our self.

2.2. Multivariate Statistical Analysis

Multivariate statistical analysis partially based on computational statistical pipeline developed by Dago et al. (2019) [16]. Indeed, data were analyzed in the R (statistical package) programming environment by integrating several packages and/or scripts including descriptive and analytical statistical tests at significant level α=0.05. In addition, data normalization based on logarithmic transformation methodology because of it good performance in reducing data variability and as well as adjusting data normality [17, 18].

Computational statistical analysis include the following R software package:

1) In R the multcompView allows to run the Tukey test by TukeyHSD () function offering a chart that shows the mean difference for each pair of group [19].
2) We performed a single step multiple comparison procedure and statistical test. It is a post-hoc analysis, what means that it is used in conjunction with an ANOVA.
3) We calculated the cumulative distribution of recurrently diagnosed diseases at Korhogo Regional Hospital (KRH) basing on arranged age class interval by applying R empirical cumulative distribution function ecdf( )). The ecdf () function in R Language is used to compute and plot the value of the Empirical Cumulative Distribution Function of a numeric vector. The ecdf () function takes the data vector (in this case recorded diseases frequency each year) as an argument and returns the CDF data.
4) We performed R linear model regression analysis liking mathematically, recurrently diagnosed diseases frequency at KRH to patient's age anthropomorphic parameter (age class interval). Linear regression is a regression model that uses a straight line to describe the relationship between variables. It finds the line of best fit through your data by searching for the value of the regression coefficient(s) that minimizes the total error of the model. Linear programming is one of the most useful and extensively used techniques of operational research. It is one special case of mathematical optimization, where the function to optimize and the constraints are linear functions of the decision variables. Posterior developments of linear programming include the possibility of defining some decision variables as integer, widening the range of problems solvable by linear programming considerably [20].
5) We compared the performance of the occurrence of recorded diseases at KRH from 4014 to 2018 by R fitting curve analysis. Curve fitting is one of the basic functions of statistical analysis. It helps us in determining the trends and data and helps us in the prediction of unknown data based on a regression model/function.
6) We performed P value clustering analysis to evaluate hierarchical interaction between diseases categories assessing the relationship between them and aging [21].

The assumption of homogeneity is important for ANOVA testing and in regression models. In ANOVA, when homogeneity of variance is violated there is a greater probability of falsely rejecting the null hypothesis. In regression models, the assumption comes in to play about residuals. In both cases it useful to test for homogeneity. To assess generated disease groups homogeneity we performed Flinger Killeen test; a non-parametric test for homogeneity of variance across groups.

To assess data (recorded diseases frequency at KRH) normality, we executed Shapiro-Wilk's method that is widely recommended for normality test. It is based on the correlation between the data and the corresponding normal scores.

3. Results

1. *Assessment of variance variability in characterizing gender of patients associated to the recurrently diagnosed diseases at KRH*

We performed the analysis of variance by assessing KRH visiting patients' gender frequency difference for year 2014, 2015, 2016, 2017 and 2018. Tukey multi-comparative survey integrated to ANOVA at confidence level 0.95, shown significant impact of patients gender vis-à-vis of diagnosed diseases data variability from 2014 to 2018 ($p<0.05$). Partial comparative ANOVA test discriminated year 2018 as a source of patient gender variability in term of recurrently diagnosed diseases at KGH, when compared to years 2014 ($p=0.000$), 2015 ($p=0.002$) and 2016 ($p=0.001$) (Figure 1). The same analysis suggested significant data variability for female gender as opposite to male gender by comparing year 2018 to years 2014 ($p=0.003$), 2015 ($p=0.005$) and year 2016 ($p=0.05$) (Figure 1 and Table A1). Linear model analysis assessing the relationship between recurrently diagnosed diseases at KRH and patients' gender from 2014 to 2018, exhibited year 2018 factor associated to female modality as an excellent estimator in predicting patient sex ($p=0.00$). In addition, significant statistic has been associated to the intercept coefficient of the predicting model ($p=0.02$). Global fisher test associated to that linear predicting model results are as following; F-statistic =3.96 on 9 (gender and year combination) and 170 DF (recurrently diagnosed diseases at KRH for male and female patients from 2014 to 2018), $p=0.00$, suggesting a significant relationship between recurrently diagnosed diseases at KRH and patients gender from year 2014 to year 2018. Of note, comparative analysis between male and female patients frequency in term of recurrently diagnosed diseases at KRH, for the study period shown a relative significant difference between female and male gender ($p=0.07$; Figure A1).

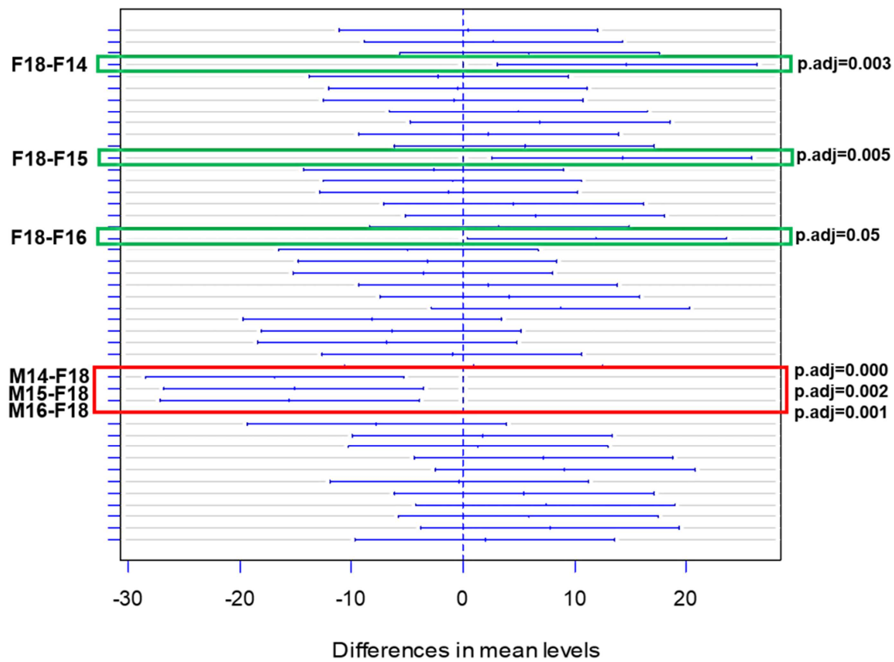

Figure 1. *Tukey multiple comparative analysis at 0.95 confidence level evaluating diagnosed disease differences mean level by patient gender. M acronym is for male patient while F acronym is for female patient. Acronyms M14, M15 and M16 refer to male patients' recorded at KGH during years 2014, 2015 and 2016. Acronyms F14, F15, F16 and F18 refer to female patients' collected at KGH during years 2014, 2015, 2016 and 2018.*

2. *Empirical Cumulative Function Assessing Recurrently Diagnosed Diseases Distribution at KRH by Age Anthropomorphic Parameter.*

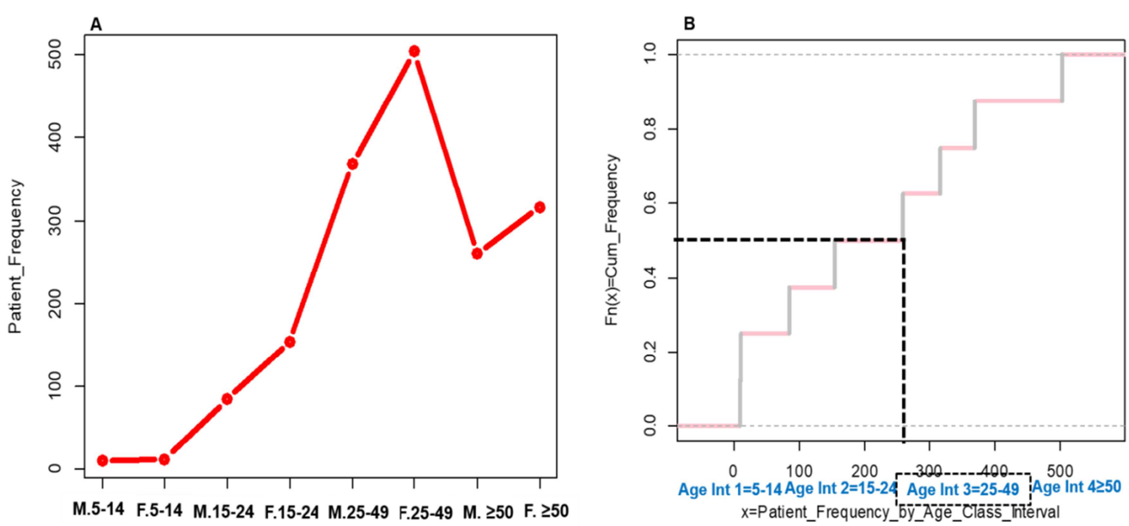

Figure 2. *Distribution of recurrently diagnosed diseases at Korhogo Regional Hospital from 2014 to 2018 by patients age/gender class intervals. (A) Diagnosed diseases absolute frequency by gender (Male and female) and by age class intervals. (B) Empirical cumulative distribution function of recurrently diagnosed diseases at KRH from 2014 to 2018.*

We previously suspected recurrent diseases occurrence at KRH with age increasing. Here we quantify this relationship by empirical cumulative distribution function. It is noteworthy to underline that we organized and/or arranged patients' age in four-class intervals basing on Yule and/or Sturges formula. Findings shown that youngest visit KRH at less (Figure 2A). In the others words, recurrently diagnosed diseases at KRH exhibit high frequency with the increasing of age anthropomorphic parameter. For all recurrently diagnosed diseases by considering age raking from five (5) to 14 years, there is no significant difference between male and female patients (p>0.05). Interestingly, difference between male and female patients start becoming significant with the increasing of age parameter (p=0.07) and became strongly significant for age group above 24 years (p=0.01) with the dominance of female patient population (Figure 2A). This tendency tends to be reversed after half of a century life where male patients frequency become dominant (p=0.16) (Figure 2A). Empirical cumulative function assessing recurrently diagnosed diseases at KRH from 2014 to 2018 exhibited 25-49 age class interval as median age class (Figure 2B). In the others words, the majority of patients visiting KRH in terms of recurrently diagnosed diseases are aged 25 and over. Recurrently diagnosed diseases frequency increases drastically form age class interval (15-24) to (25-49), with a strong and significant increase of female patient cases ($p<0.05$) (Figure 2). Considering as a whole, age anthropomorphic parameter in terms of aging, strongly influences occurrence of recurrently diagnosed diseases at KRH and highlight high proportion of the female cases to this purpose.

3. *Relationship between age and the occurrence of recurrent diagnosed diseases (from 2014 to 2018) at KRH by a linear regression model survey*

Because of well establishing mathematical link between patient age and recurrently diagnosed diseases rate at KRH, we developed a linear regression model with the purpose to characterize statistically this relationship. After normalizing data, we checked for linear regression associating patient age and gender with the occurrence of recurrent pathologies recorded at KRH from 2014 to 2018 for each age class interval. In the developed models, we assumed age as explicative variable, while recurrent diseases occurrence frequency refers to the response variable with two modalities (male and female). Multiple linear regression analysis equation for female patient gender is as following (E1): Recurrent Diagnosed Diseases Frequency (y) = 1.74*Age (x) - 0.52. Inference statistic associated to age estimator of equation (E1) linear model is significant ($p=0.02$). The model exhibits 0.11 as residual standard error on 2 degrees of freedom (DF) with multiple R-squared associated value = 0.95. F statistic results, associated to this model is as following: F-statistic=42.65 on one (1) and two (2) DF with $p=0.02$. Taking together age anthropomorphic parameter (linear regression model estimator) increasing, significantly induces the augmentation of recurrent diagnosed diseases frequency at KRH for female patient's cases ($p<0.05$). We performed the same survey for male patients. We summarized the results of this model as following in equation (E2): Recurrent Diagnosed Diseases Frequency (y) = 1.81*Age (x) - 0.67. Statistic associated to age estimator of the present developed model is significant ($p=0.02$). Fisher statistic associated to equation (E2) results are the following: residual standard error=0.11 on 2 DF with multiple R-squared = 0.96. F-statistic = 1 and 2 DF with $p=0.02$. Considering as a whole, aging results to be an excellent predictor with regard recurrently diagnosed at KRH.

4. *Performance assessment of age parameter on the typologies of recurrently diagnosed diseases at KRH from 2014 to 2018*

Empirical cumulative distribution function shown difference diseases distribution for patients' age organized in class interval (Figure 3). However, cardiovascular and osteo-articular/muscular diseases typologies exhibit the quite similar trend (Figure 3B and D). All processed diseases frequency exhibit asymmetric distributions for generated age class intervals (Figures 3G, 3H, 3I, 3J, 3K and 3L). Interestingly, aging drastically influences cardiovascular, osteo-articular/muscular and metabolic diseases (Figures 3B, 3C and 3D) as opposite to infectious and parasitical diseases as well as respiratory and digestive diseases (Figures 3A, 3E and 3F). In the others words, infectious and parasitical diseases as well as respiratory and digestive diseases exhibit a relative correct normal distribution as opposite to cardiovascular and metabolic diseases (Table 1), basing on generated age class intervals. Of note, Shapiro normality test supported this evidence (Table 1). It is noteworthy to underline that Shapiro test, assessing the normal distribution of recurrently diagnosed diseases at KRH, basing on age class intervals, clustered together cardiovascular and osteo-articular/muscular diseases and as well respiratory and digestive diseases (Table 1). These results are in agreement with the empirical cumulative distribution function analysis (Figure 3) and as well confirmed by p-value clustering survey (Figure A1). However, of note, we previously shown that all selected recurrently diagnosed diseases typologies rate, at KRH increases, with the increasing of patients' age (Figure 2A). ANOVA test supported this evidence by showing a relative variance difference between recurrently diagnosed diseases typologies at KRH from 2014 to 2018 ($p=0.11$), clustered basing on age class intervals. Because of suspected variance homogeneity among analyzed recurrently diagnosed diseases typologies, we performed Fligner-Killeen test and checking for alternative hypothesis; at least two diseases group exhibit different behavior replying to age. This analysis confirmed variance homogeneity between studied recurrently diagnosed diseases at KRH from 2014 to 2018 ($p=0.06$). Taking together, finding suggested stable variance regarding recurrently diagnosed diseases typologies at KRH advising normality significance fitting for chronic diseases as opposite to infectious and parasitical diseases.

Table 1. *Shapiro test analyzing the normality (data normal distribution) of recurrently diagnosed diseases at KRH from 2014 to 2018.*

	Infectious and Parasitical Diseases	**Cardiovascular Diseases**	**Metabolic Diseases**	**Osteo Articular and Muscular Diseases**	**Respiratory Diseases**	**Digestive Diseases**
Shapiro coefficient (w)	0.88	0.83	0.80	0.85	0.95	0.92
p	0.17	0.06	0.03	0.1	0.71	0.45
Test decision	Distribution does not relatively deviate significantly form normality	Distribution does not deviate relatively significantly form normality	The distribution significantly differs significantly for normality	Distribution does not relatively deviate significantly form normality	Distribution does not deviate significantly form normality	Distribution does not deviate significantly form normality

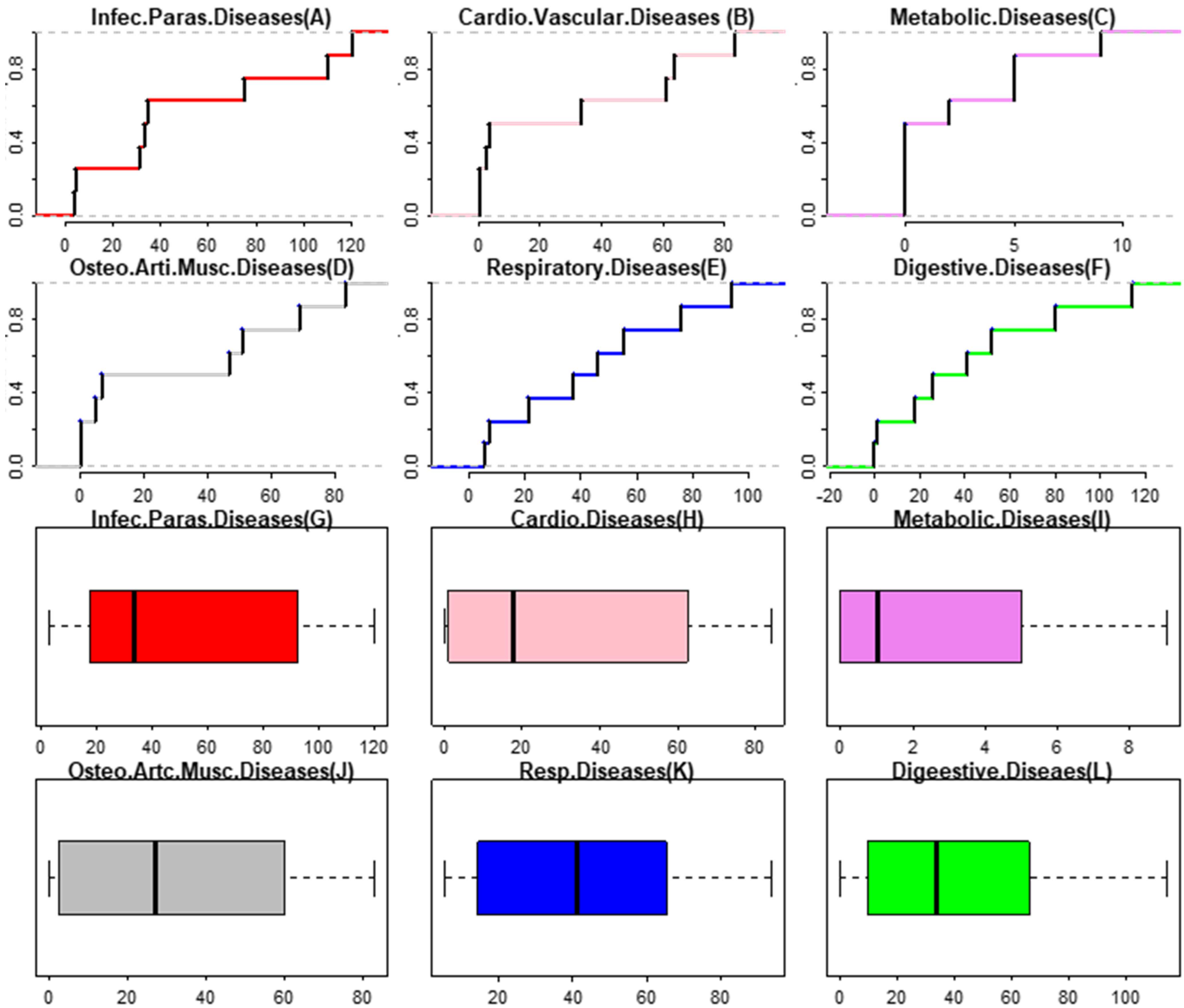

Figure 3. *Empirical cumulative distribution function assessing recurrently diagnosed distribution by processing age class intervals parameter (A, B, C, D, E and F). Multivariate boxplot survey evaluating symmetric distribution of recurrently diagnosed diseases typologies at KRH from year 2014 to year 2018 (G, H, I, J, K and L). X abscise refers to patient absolute frequency (A, B, C, D, E, F, G, H, I, J and L). Y ordinate is for cumulative function value of patient's absolute frequency (A, B, C, D, E and F).*

5. Trend and prevalence analysis of chronic and recurrent diseases diagnosed at KRH from 2014 to 2018

Our analysis shown a high proportion (25.42%) of infectious and parasitical diseases as recurrently diagnosed pathologies at general medicine division of KRH for study period (Table 2). Analysis also revealed high frequencies respectively for respiratory (21.14%) and digestive (20.58%) diseases as opposite metabolic troubles that exhibit the lowest patient frequency (Table 2). Of note, finding revealed high relative patient frequencies associated to osteo-articular, muscular (16.24%), and cardiovascular (15.31%) diseases (Table 2). As previously highlighted (Figure 2), R maplot descriptive analysis supports recurrently diagnosed diseases frequency increasing for patient age over 25 years (Figure 4). Interestingly, this analysis highlighted a high heterogeneity with regard infectious and parasitic and as well, digestive diseases frequency associated to generated age class intervals. Osteo-articular/muscular and respiratory pathologies typologies display a relative regular increasing dynamism by contrast to infectious and parasitic and as well, digestive diseases by considering arranged age class intervals (Figure 4). Of note, cardiovascular diseases exhibit regular increasing dynamism with age increasing (Figure 4). Taking together, increasing of osteo-articular/muscular diseases and cardiovascular troubles cases, exhibit a good concordance with the increasing of age anthropomorphic parameter. Osteo-articular and muscular diseases (12.01%-15.76%) and cardiovascular pathologies (8.81%-12.94%) display the highest prevalence for patients' age over 50 years (Table 2 and Figure 4). Of note, for age over 50, chronic diseases such as osteo-articular muscular diseases, cardiovascular diseases dominated by hypertension troubles, metabolic and/or diabetes diseases and digestive diseases shown a clear and strong increase in their frequency (Figure 4).

Table 2. *Prevalence of chronic and recurrently diagnosed diseases at Korhogo Regional Hospital from 2014 to 2018 clustered by gender and age class intervals 50 + years.*

	Infectious and parasitical diseases		**Cardiovascular diseases**		**Osteo-articular and muscular diseases**		**Metabolic diseases**		**Respiratory diseases**		**Digestive diseases**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Frequency (50+ years)	33	31	64	84	47	69	2	9	55	46	41	52
Prevalence (%) (50 + years)	6.19%	5.82%	12.01%	15.76%	8.81%	12.94%	0.38%	1.69%	10.32%	8.63%	7.69%	9.76%
Mean (all patients)	51.25		30.88		32.75		2.63		42.63		41.5	
SD (all patients)	45.25		34.54		33.71		3.38		31.85		39.65	
Prevalence (%) all patients	25.42%		15.31%		16.24%		1.31%		21.14%		20.58	

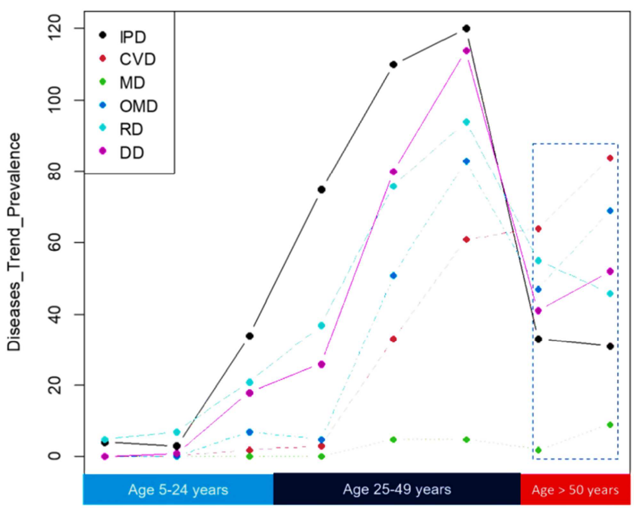

Figure 4. *R-maplot survey analyzing recurrently diagnosed diseases prevalence at KRH from 2014 to 2018 clustered by age class intervals. IPD: Infectious and parasitical diseases; CVD: Cardiovascular diseases; MD: Metabolic diseases; OMD: Ostea-articular/muscular diseases; RD: Respiratory diseases; DD: Digestive diseases.*

6. R curve fitting survey assessing descriptive mathematical relationship between chronic diseases (osteo-articular/muscular and diabetes diseases and cardiovascular and digestive troubles) and age.

We checked for a mathematical interaction between recurrently diagnosed chronic diseases at KRH and age parameter. For this purpose, we developed a nonlinear statistical model by R fitting curve survey. Findings confirmed the high concordance between getting old and the occurrence of chronic diseases (Figure 5). Of note, this trend is accentuated for high blood pressure trouble (hypertension). In addition, the R fitting curve analysis highlighted osteo-articular muscular diseases and as well digestive troubles as well correlated with aging (Figure 5). Even if exhibiting a high rate in older patient (age over 50 years), respiratory diseases display a conflicting relationship with old getting parameter (Table 2 and Figures 4 and 5). When compared to infectious and parasitical diseases, all considered chronic diseases frequency strongly increase with aging (Figure A2). In addition, osteo-articular muscular and digestive chronic diseases are not recorded in youngest patients (5≤age<24) as opposite to metabolic and high blood pressure troubles (Figure 5). In the same tendency, metabolic disease (diabetes) cases were rarely observed in youngest patients. For age over 25 years, the frequency of all considered chronic diseases increase significantly. Of note, this increasing became conflicting for age over 50 years for all chronic diseases except to metabolic disease (Figure 5). In the other words, for age class interval 25 years to 50 years, chronic diseases meanly display regular increasing with constant variance. This trend is inversed for age over 50 years. Taking together, age anthropomorphic parameter strongly influences chronic diseases occurrence dynamism, depending on early and/or late old getting.

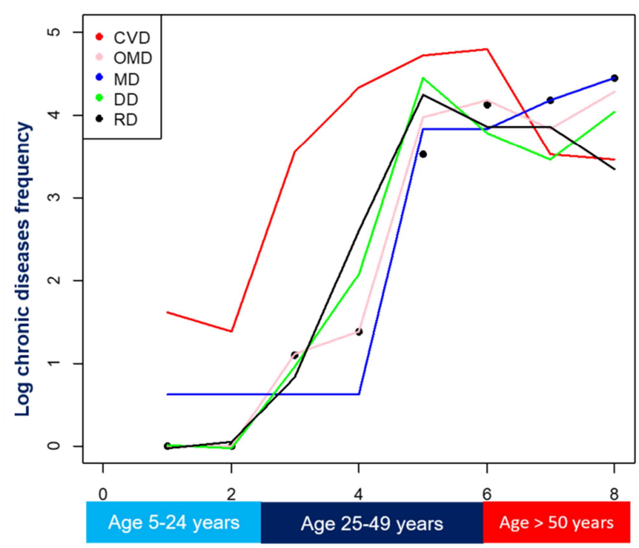

Figure 5. *R fitting curve survey assessing age impact on chronic diseases increasing frequency; i.e. OMD: Osteo-articular muscular diseases, MD: metabolic disease, DD: digestive disease, CVD: cardio vascular disease and RD: respiratory disease.*

4. Discussion

Several studies shown age of onset as an important outcome to characterize a population with a chronic disease [9, 22-24]. Basing on WHO prediction, people in Africa are living longer than ever before. Although, the region continues to face infectious diseases [12, 25, 26], the prevalence of risk factor for chronic diseases is increasing. Of note, even if infectious disease burden is, however, more devastating since it affects all components of human development, including income, health and education, non-communicable diseases such as cancer and diabetes will be among the main causes of mortality in African regions. We checked for the relationship between chronic diseases occurrence and old getting in Korhogo locality

Northern of Cote d'Ivoire a Western Africa country for five consecutive years (from 2014 to 2018). Findings, clearly suggested that chronic diseases i.e. cardiovascular diseases dominated by it hypertension component, osteo-articular and muscular diseases, metabolic, digestive, and as well respiratory diseases occurrence, as significantly influenced by aging as opposite to infectious and parasitical diseases. Of note, high blood pressure troubles cases represent the highest proportion of pathology with regard recurrently diagnosed diseases at Korhogo Regional Hospital (KRH) from 2014 to 2018 for age over 50 years. The proportion of female patients with hypertension trouble in the present study is relatively high in comparison to male patients. Indeed, the chance of having high blood pressure increases as getting older especially isolated systolic hypertension [27, 28]. Of note, before age 55, men have greater chance of having high blood pressure [9, 29, 30]. Indeed, Daugherty et al (2011) [30] shown that younger men and older women had lower rates of hypertension control compared to similarly aged peers. Women are more likely to have high blood pressure after menopause [28]. Indeed, premenopausal women have lower blood pressure than age-matched men, and women have higher rates of hypertension than men as they age [31]. It is noteworthy to underline that the study revealed some hypertension cases in young population. Therefore, there is a progressive increase in blood pressure with aging, beginning in childhood and continuing into adulthood [32]. Although increasing with old getting, findings revealed some metabolic diseases, dominated by type 2 diabetes cases linked to young age, but in reduce proportion than high blood pressure cases (age $\leq$ 24 years). Moreover, type 2 diabetes used to be called adult-onset diabetes because it was rarely diagnosed in children. Age is a considerable risk factor for type 2 diabetes. Indeed, the present results confirmed this tendency, since metabolic troubles sturdily increase for age over 50 years. The older you are, the more likely you are to have it. That also holds true for preteens and teenagers, whose diabetes rates have climbed sharply in recent years. Of note, type 2 diabetes was mainly seen to affect adults, while type 1 diabetes was more common in children and young adults. Our findings clearly exhibit type 2 diabetes occurrence increase with rising age. Indeed, the prevalence of glucose intolerance increases with advancing age. The main factors of that metabolic disorder are that aging induces decrease insulin sensitivity and alteration or insufficient compensation of beta cell functional in the face of increasing insulin resistance [33, 34]. However, now, more children are receiving type 2 diabetes diagnoses [35]. Findings shown osteo-articular, respiratory and digestive troubles cases as missing and/or rarely observed in young age population. Of note, our finding supported strong increasing respectively for osteo-articular, muscular and digestive pathologies and/or troubles for age over 50 years as opposite to respiratory diseases. The prevalence of osteo-articular and muscular troubles increases with age such that 30 to 50% of adults over the age of 65 years suffer from this condition [35]. The relationship between aging and this physiological state is well known but the mechanisms for how aging predisposes the joint to developing oste-articular troubles are still not fully understood [36]. Changes both intrinsic to the joint as well as those extrinsic contribute to the development of osteo-articular and muscular diseases. The concept that aging contributes to, but does not directly cause osteo-articular and muscular troubles, is consistent with the multifactorial nature of this condition and the disparity in which joints are most commonly affected [37]. In addition, although the frequency and severity of osteo-arthrosis regularly increase after the age of 50 years, individual's age does not seem to be a causal factor of this disorder. Indeed, osteo-arthrosis does not affect all age individuals and not all joints are involved at the time [38]. R fitting comparative survey shown significant increase of digestive diseases rate for age over 50 years. Aging affects all functions of the gastrointestinal system, i.e. motility, enzyme and hormone secretion, digestion, and absorption. The gastro intestinal system also plays an essential role in medication absorption and metabolism, and it is commonly affected by side effects. While there is no digestive and/or gastro-intestinal diseases that are specific and limited to advanced age, some illnesses are more prevalent in this age group and may require different management. Our study revealed several gastritis cases as gastro-intestinal recurrent pathology at KRH. Of note, the elderly have an increased prevalence of gastritis and the complications associated with it [39-41]. An age-related increase in the frequency of Helicobacter pylori (formerly Campylobacter pylori) infection in the elderly parallels the known age-related increase in the prevalence of gastritis. The close association between gastritis in the elderly and hypochlorhydria and gastric carcinoma is also explored highlighting digestive system troubles occurrence and old getting [40, 41]. R fitting curve analysis by assessing mathematical relationship between parasitical and infectious diseases (malaria, AIDS, tuberculosis, varicella, hepatitis, herpes, influenza, gastroenteritis and shingles) and chronic diseases (hypertension, diabetes, cholopaty, gastritis, asthma, osteo-articular and muscular disease, cardiovascular diseases…) diagnosed at KRH highlighted age anthropomorphic parameters as significantly impacting chronic diseases occurrence. Indeed, Noel et al. (2022) [2] shown a strong relationship between high blood pressure occurrence and aging at KRH northern of Cote d'Ivoire. An age-related increase in blood pressure is viewed as a universal feature of human aging [42, 43]. By contrast to hypertension disturbs and/or chronic pathology, infectious and parasitical disease occurrence dominated by malaria at KRH do not depend on patients age [2]. Of note, animal (zoonotic), food, blood, water and insect (that is, malaria) can transmit parasitic diseases. Malaria transmission depends on climatic conditions that may affect the number and survival of mosquitoes, such as rainfall patterns, temperature and humidity. In many places, transmission is seasonal, with the peak during and just after the rainy season. Malaria epidemics can occur when climate and other conditions suddenly favor transmission in areas where people have little or no immunity to malaria [44, 45]. They can also occur when people with low immunity move into areas with intense malaria transmission. Some population groups are at considerably higher risk of contracting malaria. These include infants, children under 5 years of age, pregnant women [44, 45] and patients with HIV/AIDS, as well as non-immune migrants, mobile populations and travelers.

5. Conclusion

Considering as a whole, the present study clearly shown aging as significantly contributing of the rapid emergence of chronic diseases, i.e. high blood pressure, osteo-articular and muscular diseases as well as metabolic pathology (diabetes), in a preoccupant COVID-19 pandemic context, in Korhogo locality in northern of Cote d'Ivoire a Western Africa country.

Conflict of Interests

The authors declare that they have no competing interests.

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Appendix

Table A1. *Whole Tukey multiple comparative analysis at 0.95 confidence level evaluating diagnosed disease differences mean level.*

	Diff	Lwr	Upr	P adjusted
F.15 –F.14	0.44	-11.16	12.05	1
F.16 – F.14	2.72	-8.89	14.33	0.99
F.17-F.14	5.94	-5.66	17.55	0.82
F.18-F.14	14.67	3.06	26.27	0.003**
M.14-F.14	-2.22	-13.83	9.39	0.99
M.15-F.14	-0.5	-12.11	11.11	1
M.16-F.14	0.88	-12.50	10.72	0.99
M.17-F.14	4.94	-6.66	16.55	0.94
M.18-F.14	6.89	-4.72	18.5	0.67
F.16-F.15	2.28	-9.33	13.88	0.99
F.17-F.15	5.50	-6.11	17.11	0.88
F.18-F.15	14.22	2.61	25.83	0.005**
M.14-F.15	-2.67	-14.27	8.94	0.99
M.15-F.15	-0.94	-12.55	10.66	0.99
M.16-F.15	-1.33	-12.94	10.27	0.99
M.17-F.15	4.5	-7.11	16.11	0.96
M.18-F.15	6.44	-5.16	18.05	0.75
F.17-F.16	3.22	-8.40	14.83	0.99
F.18-F.16	11.94	0.34	23.55	0.04**
M.14-F.16	-4.94	-16.55	6.66	0.94
M.15-F.16	-3.22	14.82	8.40	1
M.16-F.16	-3.61	-15.22	8.00	0.99
M.17-F.16	2.22	-9.40	13.83	1
M.18-F.16	4.17	-7.44	15.77	0.98
F.18-F.17	8.72	-2.89	20.33	0.33
M.14-F.17	-8.16	-19.77	3.44	0.42
M.15-F.17	6.44	-18.05	5.16	0.75
M.16-F.17	-6.83	-18.44	4.77	0.68
M.17-F.17	-1	12.61	10.61	1
M.18-F.17	0.94	-10.66	12.55	1
M.14-F.18	-16.89	-28.50	5.28	0.000***
M.15-F.18	-15.17	-26.77	-3.56	0.002***
M.16-F.18	-15.56	-27.16	-3.95	0.001***
M.17-F.18	-9.72	-21.33	1.89	0.19
M.18-F.18	7.78	19.40	3.83	0.50
M.15-M.14	1.72	-9.89	13.33	1
M.16-M.14	1.33	10.27	12.94	1
M.17-M.14	7.17	-4.44	18.77	0.61
M.18-M.14	9.11	-2.50	20.72	0.27
M.16-M.15	-0.39	-12	11.21	1
M.17-M.15	5.44	-6.16	17.05	0.89
M.18-M.15	7.39	-4.22	19	0.57
M.17-M.16	5.83	-5.77	17.44	0.84
M.18-M.16	7.78	-3.83	19.39	0.50
M.18-M.17	1.94	-9.66	13.55	1

*** Statistically significant differences at $p \leq 0.05$.

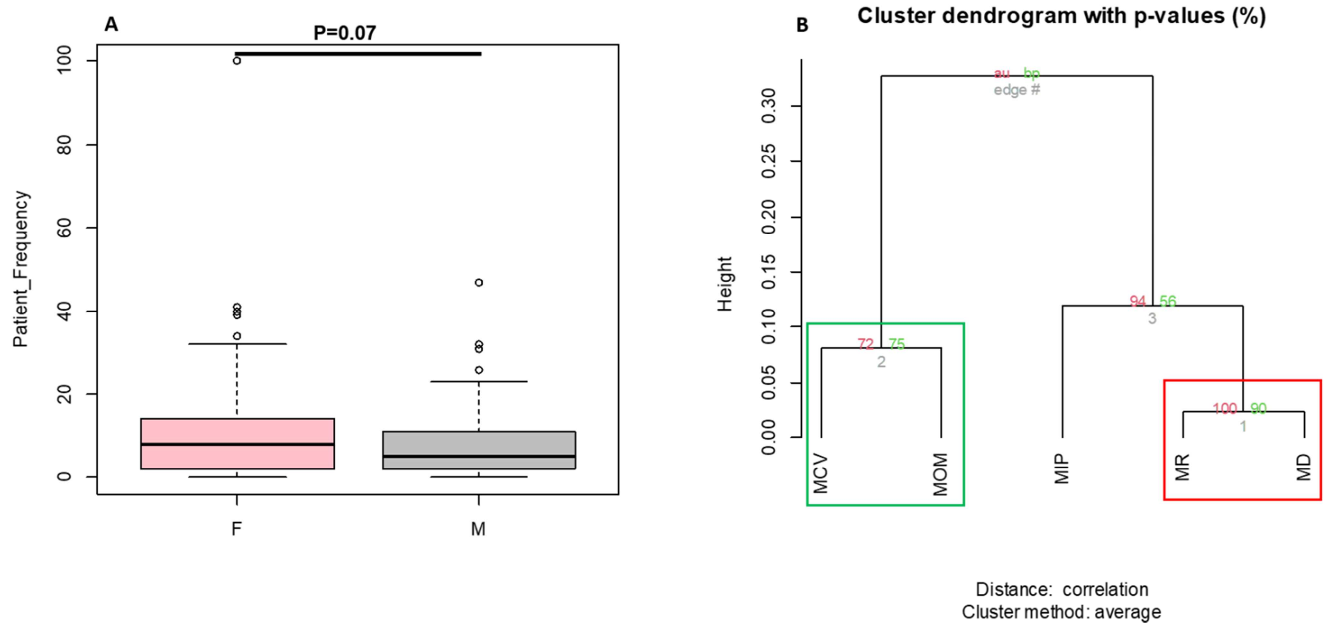

Figure A1. *Multivariate boxplot analysis comparing male and female patients' frequency in term of recurrently diagnosed diseases at Korhogo General Hospital (KGH) from 2014 to 2018. F= female patients, M= Male patients visiting KGH from 2014 to 2018. Cluster dendrogram p-value (%) by correlation distance average clustering recurrently diagnosed diseases typologies at KRH from 2014 to 2018. MCV = Cardiovascular Diseases; MOM= Osteo-articular/muscular Diseases; MIP= Infectious and Parasitical Diseases; MR= Respiratory Disease and MD= Digestive Diseases.*

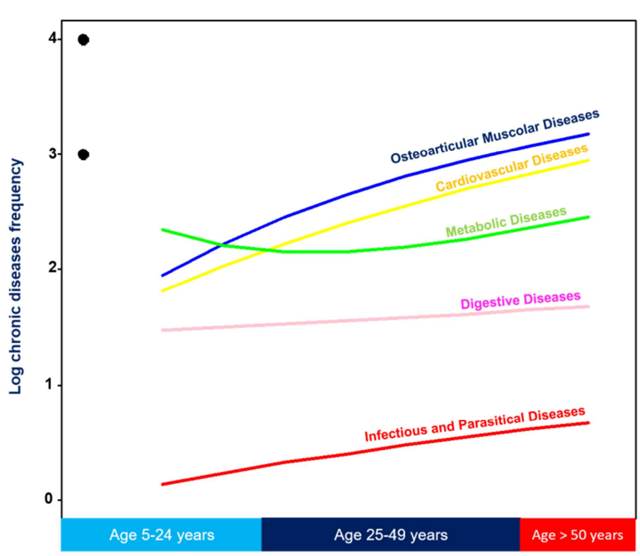

Figure A2. *R fitting curve analysis assessing age anthropomorphic parameter influence on chronic diseases at KRH by nonlinear regression model comparing chronic diseases such as diabetes (metabolic diseases), hypertension (cardiovascular diseases), osteo-articular muscular diseases and digestive diseases and infectious and parasitical diseases.*

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