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COMPARATIVE ANALYSIS OF RENAL IMPAIRMENT IN POSITIVE AND NEGATIVE HIV-INDIVIDUALS AT KONO GOVERNMENT HOSPITAL, SIERRA LEONE

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ABSTRACT

Background: Non-communicable disease is of major concern affecting a significant portion of the global population, furthermore renal impairment is of great concern and has affected so many lives. It is a serious and gradual condition marked by the progressive deterioration of kidney function. In recent years, Renal impairment has emerged as a clinically relevant and significant issue. The aim of this study was to compare analysis of renal impairment in individuals with HIV, diabetes, and hypertension.

Methods: This was a cross-section quantitative study. It was conducted from June to September 2024. A total of Two Hundred and Seventy-Five (275) participants were selected using a consecutive sampling technique. Serum creatinine and CD4 counts were measured in HIV-positive individuals, and the eGFR was calculated using the CKD-Epi 2021 formula. Data analysis was done using SPSS version 16.

Results: Among the study population, 158 participants (57.5%) were HIV-positive, while 62 (39.2%) and 55 (34.8%) were HIV-negative individuals diagnosed with hypertension and diabetes, respectively. The overall prevalence of renal impairment was found to be 34.2% (n = 54) among HIV-positive individuals, 30.6% (n = 19) among hypertensive participants, and 38.2% (n = 21) among those with diabetes. Participants aged 31–40 years demonstrated a significantly higher likelihood of renal impairment (adjusted odds ratio [aOR] = 5.37; 95% CI: 2.414–12.489), as did those over 50 years (aOR = 4.93; 95% CI: 1.491–16.351). Among diabetic participants, older age was also significantly associated with renal impairment (aOR = 6.379; 95% CI: 1.129–36.060). Furthermore, hypertensive females were identified as having an increased risk of developing renal impairment.

Conclusion: The prevalence of renal impairment was notably high among the study participants. Increased age was linked to renal impairment, and also females within the hypertensive group.

Keywords: Renal Impairment, Diabetes, HIV-AIDS, Hypertension, eGFR.

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INTRODUCTION

Non-communicable disease is of major concern affecting a significant portion of the global population, furthermore renal impairment is of great concern and has affected so many lives. It is a serious and gradual condition marked by the progressive deterioration of kidney function (Couser et al. 2011). In recent years, Renal impairment has emerged as a clinically relevant and significant issue (Huang et al., 2017). The consequences of renal impairment can include acute kidney injury (AKI), chronic kidney disease (CKD), end-stage renal disease (ESRD), or death (Campos, Ortiz and Soto, 2016). A sudden loss of excretory kidney function defines AKI. AKI is part of a range of conditions summarized as acute kidney diseases and disorders (AKD), in which slow deterioration of kidney function or persistent kidney dysfunction is associated with an irreversible loss of kidney cells and nephrons, which can lead to CKD (Guo et al. 2025). CKD is a progressive condition characterized by the gradual loss of kidney function over time. CKD is a global health issue that affects millions of people worldwide (Jager et al. 2019). Impaired renal function in sub-Saharan Africa has been linked to both infectious and non-infectious risk factors. Furthermore, individuals living with HIV (Human Immunodeficiency Virus), diabetes, and hypertension face a compounded burden of kidney disease due to unique risk factors and comorbidities associated with these conditions and their treatments (Tang et al. 2020) Globally, the estimated prevalence of renal function impairment among adults living with HIV, using the chronic kidney disease epidemiology collaboration formula (CKD-EPI) equation, was 4.8%. The magnitude of the phenomenon was found to be 6.5% in North America and 2.7% in Europe (Bonilla, Jhaveri, and Izzedine 2022). In Sub-Saharan Africa, individuals living with HIV have a high prevalence of renal function impairment, ranging from 25-77% (Thongprayoon et al. 2020). There have been several studies on the use of Tenofovir Disproxil Fumarate to be linked with acute kidney injury and chronic kidney disease (Kumar et al. 2008). Still, no previous studies have been conducted on its effects in our setting as TDF is one of the first-line treatments for HIV in Sierra Leone (Idowu et al. 2018).

Diabetes mellitus is a long-term disorder caused by high blood sugar levels due to defects in insulin secretion, insulin action, or both. It has become a global epidemic, with an estimated 537 million adults worldwide living with diabetes by 2024(Hossain, Al-Mamun, and Islam 2024). Among the various complications associated with diabetes, renal impairment is a significant and debilitating complication, which significantly impacts patients' quality of life and increases mortality rates (Thomas, Cooper, and Zimmet 2016). The aim of this study was to compare renal impairment among individuals with HIV, diabetes, and hypertension to understand how each condition affects kidney function differently.

METHODS

Study Design

A Comparative cross-sectional study was conducted on patients at Kono Government Hospital who are sent to perform their routine laboratory testing at the Koidu Government Hospital Laboratory.

Population and Sampling

The study population target was adults ≥ 18 years as enrolled at the HIV Clinic and Non-Communicable Disease Clinic at the Koidu Government Hospital, Kono, from July 2024 to

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September 2024.

A Consecutive sampling technique was used since the study is laboratory-based, and patient selection is based on enrolment into the facility. Participants were either HIV-positive, confirmed through serological testing, or HIV-negative, confirmed by serological testing or medical records. Eligible individuals also had to have relevant clinical, laboratory, and demographic data available for the analysis. Additionally, HIV-negative participants who were already diagnosed of having diabetes mellitus and hypertension were recruited as well. The study included pregnant women, individuals undergoing dialysis, those with missing or incomplete clinical, laboratory, or demographic data, and patients with other comorbidities.

Blood Sample Collection and Handling

About 3 mls and 2 mls of venous blood was drawn using a vacutainer needle and holder into a plain specimen bottle for renal function test (state parameters that were done in renal function tests) and an EDTA specimen bottle for CD4 analysis respectively. The sample was collected following proper procedures to avoid blood haemolysis and to ensure safety of the participants.

The sample collected in the red-topped tube was promptly transported to the Biochemistry Department, where it was centrifuged at 3500 rpm for 10 minutes to facilitate serum separation. The resulting serum was immediately used for biochemical analyses.

In contrast, the sample collected in the EDTA tube was not centrifuged, as whole blood is required for CD4 analysis using the Pima™ CD4 Analyzer.

Ethical clearance

Ethical clearance was obtained for the commencement of this research through the Sierra Leone Ethics Board.

RESULTS

The findings of a detailed comparative analysis of renal function (serum creatinine) across three distinct groups: HIV-positive individuals, patients with hypertension, and those with diabetes were presented. It focuses on key outcomes, particularly estimated glomerular filtration rate (eGFR) levels, and explores the patterns and severity of renal impairment in each group.

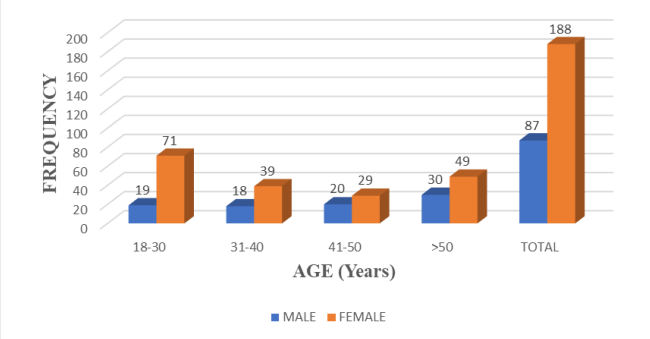

Figure1: A graph showing Age-Sex distribution

The figure 1 above indicates the different age groups and sex distribution present in this study. The largest number of participants are females and adults aged 18-30 years, followed by adults greater than 50 years

Table 1: Characteristics of HIV-Positive and HIV-Negative individuals attending ART clinic and NCD clinic respectively at Kono Government Hospital, Koidu Town, Sierra Leone.

The majority of the study participants were HIV-positive 158 (57.5%), followed by 117(42.5%) HIV-Negative individuals which consisted of 55 (20.0%)

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Diabetic patients, and 62(22.5%) Hypertensive patients (Table 1). The mean age of HIV-positive, hypertensive, and diabetic patients was 34.1, 53.8, and 46.1 years respectively. Hypertensive patients with the highest mean, followed by diabetes **(Table 1).**

Table 2: Comparison of eGFR of the study participants for HIV-Positive and HIV-Negative individuals

Table 2. shows the mean eGFR was highest (75.5 mL/min/1.73m^2) in HIV-Positive adults followed by 71.5 ml/min/1.73m^2 in HIV-Negative (Hypertension) and Lowest (66.6 ml/min/1.73m^2) in HIV-Negative (Diabetes adults). Diabetes adults have a larger proportion (16.4%) of participants with moderate to severely impaired renal function, followed by Hypertension (11.3%), and then HIV-Positive adults have the least proportion of moderate to severely impaired renal function (7.0%). However, HIV-positive adults have the highest proportion of mildly to moderately impaired renal function at 21.5% followed by Diabetes Adults.
HIV-Negative (Hypertension) adults have the highest proportion (9.7%) of severely decreased renal function followed by Diabetes adults (5.5%), and HIV-Positive adults (2.5%). Kidney failure occurred highly in Adults suffering from Diabetes (5.5%), (3.2%) in Hypertension adults, and (0.6%) in HIV-positive adults.

4.1 Prevalence of Renal Impairment in HIV-positive and HIV-negative (Diabetes and Hypertension) (eGFR < 60 ml/min/1.73m^2 is Regarded as Renal Impaired).

Table 3: Renal Impairment Status among the three Conditions

Table 3. shows, out of the 275 participants, 94 (34.2%) had renal impairment in which there are 66 (24%) females and 28 (10.2%) males. There was renal impairment in 54 (34.2%) of HIV-positive adults with females (24.1%) having the highest proportion of renal impairment in this population. Hypertension and diabetes also report females having the highest proportion, 25.8% and 21.8% respectively.

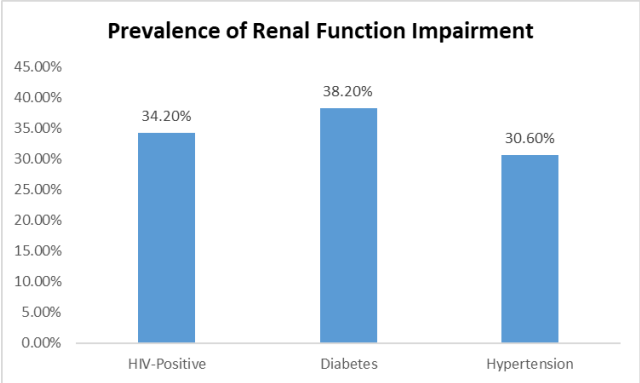

Figure 6: A graph showing the prevalence of Renal Impairment

Figure 2. shows that HIV-Negative (Diabetes) Adults have the highest prevalence of Impaired renal function (eGFR < 60 mL/min/1.73m2) at 38.2%, followed by HIV-Positive Adults (34.2%), and finally HIV-Negative (Hypertension) Adults with (30.6%).

4.2 Factors associated with renal Impairment in HIV-positive and HIV-negative (Diabetic and Hypertensive) Adults
To determine the association between renal impairment and covariates within the population, bivariable and multivariable binary logistic regression analyses were performed.

Table 4: Bivariable and Multivariable to determine the association between renal impairment and covariates in HIV-Positive and HIV=Negative Adults

In HIV-Positive Adults, Males were 14% less likely (aOR = 0.86; 95% CI: 0.37 to 1.99) to have renal impairment than females. The odd ratios indicate that sex does not significantly impact renal impairment among HIV-positive adults, as shown by the high p-value (0.719), suggesting no significant association between sex and renal impairment (Table 4.). Adults within the age limit (31 - 40) were 5.3 times more likely (aOR = 5.37; 95% CI: 2.31 to 12.48), age ranged (41 - 50) were 1.7 times more likely (AOR = 1.76; 95% CI:

0.59 to 5.22), and age > 50 years were 4.9 times more likely (aOR = 4.93; 95% CI: 1.49 to 16.25) to have renal impairment than Adults HIV-Positive within 18 - 30 years.

Age groups show a marked association with renal impairment. 31 - 40 years shows a high aOR and cOR with significant CI with a p-value <0.001. This suggests that individuals in this age have a significantly higher risk of renal impairment compared to the 18 - 30 age group. > 50 Years also shows increased odds (aOR and cOR) with significant CIs and a p-value of 0.009, indicating an elevated risk for renal impairment (Table 4.).

The study also indicates that CD4 > 500 is 30% less likely (AOR = 0.73; 95% CI: 0.24 to 2.22) to have renal impairment compared to CD4 < 200. It does not show a significant association with renal impairment. Both the aOR and cOR for CD4 counts between 200 - 500 and > 500 are below 1, with high p-values (0.940 and 0.96), indicating no significant difference in renal impairment risk based on CD4 levels (Table 4).

The odds ratios for females (aOR: 4.405; and cOR: 3.840) suggest that hypertensive females are 4.4 times more likely to develop renal impairment than hypertensive males, and show a strong statistical significance (p = 0.046) (**Table 4).** Age does not appear to significantly impact the risk of renal impairment among hypertensive adults, as indicated by the aOR; 31 - 40 years: aOR of 0.586 (0.029-11.824) p = 0.779, 41 - 50 years; aOR of 0.234 (0.014-3.836), p = 0.301, and > 50 years; aOR of 0.111 (0.007-1.655), with p = 0.124. None of these age-related associations show statistical significance, indicating that age alone may not be a determining factor for renal impairment risk among hypertensive individuals in this sample (**Table 4**).

In Diabetic Adults, Males have higher odds (aOR = 1.442) of renal impairment than females, but this association is not statistically significant (p >0.05). Therefore, sex is not a significant predictor in this model. Individuals aged over 50 have significantly higher odds (aOR = 6.379) of renal impairment compared to the 18 - 30 age group, with a statistically significant p-value (p < 0.05) (**Table 4**). This suggests that age > 50 is a significant predictor of renal impairment in diabetic adults. The age group (31 - 40 and 41 - 50) shows a non-significant reduction and increase in odds of renal impairment compared to the 18 - 30 age group respectively

DISCUSSIONS

The prevalence of renal function impairment in this study based on the estimated glomerular filtration rate using the CKD EPI 2021 equation was 34.2 % in the HIV-positive population (Asmelash and Nigatie 2024). This finding is higher than in studies that reported 20.7% in south-west Ethiopia (Kefeni, Hajito, and Getnet 2021), 23.7% (Umeizudike et al. 2012) in south-west Nigeria, 24.3% in south Nigeria (Onodugo et al. 2014) and 15.7% in rural Tanzania(Umeizudike et al. 2012). However, the prevalence of renal function impairment in this study is lower than in studies from (Kefeni, Hajito, and Getnet 2021). This variation may be due to participant differences among studies and the use of different methods to estimate GFR(Kefeni, Hajito, and Getnet 2021). A modified diet of renal disease formula was used to estimate GFR in Ghana, the Cockcroft-Gault method in north-west- and south-west Ethiopia, which might also contribute to the variation in the prevalence since CKD EPI 2021 formula was used in this study(Ephraim et al. 2015).

The prevalence of renal impairment in Diabetic individuals was 38.2 %, this finding is similar to a study in the western region of China which reports a prevalence of 41.3% (Zhang, Kong, and Yun 2020). Other regions reported a high prevalence, 83.7%% was reported in Tanzania (Mpondo, Neilson, and Ernest 2016). However, a lower proportion was reported in Ghana 16.1% (Tannor et al. 2019) with a lower prevalence was also reported in Sierra Leone with 11.4% (Russell et al. 2023).

This study reported a prevalence of renal impairment in hypertensive patients of 30.6%, which is greater than studies reported in Ghana,

which showed a prevalence of renal impairment of 26.3% among hypertensive patients (Tannor et al. 2019). 11.4% was also reported in Nigeria. A higher prevalence of 52% was also reported in Sierra Leone among hypertensive patients (Ulasi et al. 2013).

This study found that Diabetes heightened the risk of renal impairment, followed by HIV-positive individuals and then Hypertension. This study does not agree with studies conducted in Ethiopia (Kefeni, Hajito, and Getnet 2021), which say hypertension is the major cause of renal impairment. Also, diabetes and hypertension are the two leading causes of renal impairment (Elendu et al. 2023). The findings are concordant with Diabetes being the major cause of renal impairment (Matoba et al. 2020). This could be because diabetic nephropathy, a common complication of diabetes, decreases the glomerular filtration rate.

This study shows that HIV-Positive patients with older age (31 years and above were found to be more likely to develop renal function impairment. Older age is highly associated with renal impairment in HIV-positive individuals. This is consistent with previous studies done in Ethiopia (Tannor et al. 2019), South Africa (Assaram, Mashamba-Thompson, and Magula 2018), Ghana (Obiri-Yeboah et al. 2018a), and Nigeria (Odubela et al. 2024).

CONCLUSION

This study found a high prevalence of renal function impairment among adult patients, with the highest rates observed in diabetic individuals, followed by HIV-positive patients, and then those with hypertension. Older age (31 years and above) was significantly associated with renal impairment among HIV-positive participants, while age over 50 was a key risk factor among diabetic patients. Additionally, hypertensive females were found to be at greater risk for renal impairment.

RECOMMENDATION

These findings highlight the need for routine renal function screening, particularly among HIV-positive individuals receiving antiretroviral therapy (ART), to enable early detection and effective management. Similarly, regular monitoring of kidney function is recommended for diabetic and hypertensive patients to prevent progression of renal complications. Further research is also recommended to deepen the understanding of renal impairment patterns among HIV-positive, hypertensive, and diabetic adults, and to guide the development of targeted interventions

CONFLICT OF INTEREST

The Authors had no conflict of interest

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Table 1: Characteristics of HIV-Positive and HIV-Negative individuals attending ART clinic and NCD clinic respectively at Kono Government Hospital, Koidu Town, Sierra Leone.

Characteristics	N = 275	HIV-positive (%) N = 158	HIV-negative (Hypertension)(%) N = 62	HIV-Negative (Diabetes) (%) N = 55
Age (In years); Mean(Median)	275	34.1 (32)	53.8 (55)	46.05 (50)
Ages (years)				
18- 30		75(47.5)	3(4.8)	10(18.2)
31– 40		44(27.8)	7(11.3)	8(14.5)
41-50		24(15.2)	15(24.2)	11(20)
>50		15(9.5)	37(59.7)	15(27.3)
SEX	275			
Male		44(27.8)	21(33.9)	22(40)
Female		114(72.2)	41(66.1)	33(60)
CD4 Count	158	158		
<200		23(14.6)		
200-500		60(38.0)		
>500		75(47.4)		

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Table 2: Comparison of eGFR of the study participants for HIV-Positive and HIV-Negative individuals

Characteristics	***HIV-positive N = 158***	***HIV-negative (Hypertension)*** *N = 62*	***HIV-Negative (Diabetes)*** *N = 55*
eGFR (ml/min/1.73m^2), mean	75.7	71.5	66.6
eGFR categories (mL/min/1.73m^2 n(%)			
Normal (90–135)	50 (31.7)	20 (32.3)	16 (29.1)
Mildly decreased (60–89)	58 (36.7)	24 (38.7)	17 (30.9)
Mildly to moderately decreased (45–59)	34 (21.5)	3 (4.8)	7 (12.7)
Moderately to severely decreased (30–44)	11 (7.0)	7 (11.3)	9 (16.4)
Severely decreased (15–29)	4 (2.5)	6 (9.7)	3 (5.5)
Kidney failure (< 15)	1 (0.6)	2 (3.2)	3 (5.5)

Table 2. shows the mean eGFR was highest (75.5 mL/min/1.73m^2) in HIV-Positive adults followed by 71.5 ml/min/1.73m^2 in HIV-Negative (Hypertension) and Lowest (66.6 ml/min/1.73m^2) in HIV-Negative (Diabetes adults). Diabetes adults have a larger proportion (16.4%) of participants with moderate to severely impaired renal function, followed by Hypertension (11.3%), and then HIV-Positive adults have the least proportion of moderate to severely impaired renal function (7.0%). However, HIV-positive adults have the highest proportion of mildly to moderately impaired renal function at 21.5% followed by Diabetes Adults.

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Table 3: Renal Impairment Status among the three Conditions

Characteristics	*HIV-Positive Renal Impairment*		*Hypertension Renal Impairment*		*Diabetes Renal impairment*	
	YES (%)	NO (%)	YES (%)	NO (%)	YES (%)	NO (%)
Total	54 (34.2)	104 (65.8)	19 (30.6)	43 (69.4)	21 (38.2)	34 (61.8)
SEX						
Female	38 (24.1)	76 (48.1)	16 (25.8)	25 (40.3)	12 (21.8)	21 (38.2)
Male	16 (10.1)	28 (17.7)	3 (4.8)	18 (29.0)	9 (16.4)	13 (23.6)
Age (Years)						
18-30	15 (9.5)	61 (38.6)	2 (3.2)	1 (1.6)	2 (3.6)	9 (16.4
31-40	24 (15.2)	19 (12.0)	4 (6.5)	3 (4.8)	1 (1.9)	6 (10.9)
41-50	7 (4.4)	17 (10.7)	5 (8.1)	10 (16.1)	3 (5.5)	8 (14.5)
>50	8 (5.1)	7 (4.4)	8 (12.9)	29 (46.8)	15 (27.3)	11 (20)
CD4 count						
<200	8 (5.1)	15 (9.5)				
200-500	20 (12.7)	39 (24.7)				
>500	26 (16.5)	50 (31.6)				

Table 3. shows, out of the 275 participants, 94 (34.2%) had renal impairment in which there are 66 (24%) females and 28 (10.2%) males. There was renal impairment in 54 (34.2%) of HIV-positive adults with females (24.1%) having the highest proportion of renal impairment in this population. Hypertension and diabetes also report females having the highest proportion, 25.8% and 21.8% respectively.

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Table 4: Bivariable and Multivariable to determine the association between renal impairment and covariates in HIV-Positive and HIV=Negative Adults

Characteristics of HIV-positive adults	Renal impairment		cOR (95% CI)	P-value	aOR (95% CI)	P-value
	Yes	No				
Sex						
Female	38	76	1			
Male	16	28	1.143 (0.552-2.365)	0.719	0.859 (0.370-1.995)	0.723
Age (years)						
18 - 30	15	61	1		1	
31 - 40	24	19	5.137 (2.250-11.727)	< 0.001	5.376 (2.314-12.489)	< 0.001
41 - 50	7	17	1.675 (0.588 to 4.765)	0.334	1.765 (0.596-5.228)	0.305
>50	8	7	4.648 (1.455-14.841)	0.009	4.938 (1.491-16.351)	0.009
CD4						
<200	8	15	1		1	
200 - 500	20	39	0.962 (0.349-2.649)	0.940	0.731 (0.239-2.229)	0.581
>500	26	50	0.975 (0.366-2.598)	0.960	0.737 (0.245-2.215)	0.587

Characte	Renal Impairment	COR (95% CI)	P-value	AOR (95% CI)	P-value

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ristics of Hyper tensive Adults	Yes	No				
Sex						
Male	3	18	1		1	
Female	16	25	**3.840** (0.972-15.171)	0.055	4.406 (1.023-18.958)	0.046
Age						
18 - 30	2	1	1		1	
31 - 40	4	3	**0.667** (0.039-11.285)	0.779	0.586 (0.029-11.824)	0.727
41 - 50	5	10	**0.250** (0.018-3.467)	0.301	0.234 (0.014-3.826)	0.308
>50	8	29	**0.138** (0.011-1.723)	0.124	0.111 (0.007-1.655)	0.111

Charac teristics of Diabetes Adults	*Renal Impairment*		*cOR (95% CI)*	*P-value*	*aOR (95% CI)*	*P-Value*
	Yes	No				
Sex						
Female	12	21	1		1	
Male	9	13	**1.212** (0.400-3.665)	0.734	**1.442** (0.421-4.942)	0.560
Age						
18 - 30	2	9	1		1	
31 - 40	1	6	**0.750** (0.055-10.233)	0.829	**0.718** (0.052-9.891)	0.804

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41 - 50	3	8	**1.687** (0.222-12.809)	0.613	**1.812** (0.234-14.053)	0.569	In
>50	15	11	**6.136** (1.101-34.214)	0.039	**6.379** (1.129-36.060)	0.036	