

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN PSYCHOSOCIAL STRESSORS WITH CHRONIC KIDNEY DISEASE AMONG MIGRANT AND NON-MIGRANT GHANAIS: THE RODAM STUDY

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-027931
Article Type:	Research
Date Submitted by the Author:	17-Nov-2018
Complete List of Authors:	<p>Adjei Nana, David ; University of Ghana, Department of Medical Laboratory Sciences; University of Amsterdam, Department of Public Health</p> <p>Stronks, Karien; Academic Medical Center , Department of Public Health Adu, Dwomoa; Korle-bu Teaching Hospital, Department of Medicine</p> <p>Beune, Erik; AMC</p> <p>Meeks, Karlijn; AMC, Public Health</p> <p>Smeeth, Liam; London School of Hygiene and Tropical Medicine, Addo, Juliet; London School of Hygiene and Tropical Medicine, Non Communicable Disease Epidemiology</p> <p>Owusu-Dabo, Ellis; Kwame Nkrumah University of Science and Technology, Kumasi Centre for Collaborative Research in Tropical Medicine</p> <p>Klipstein-Grobusch, Kerstin; 1 Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Centre Utrecht, Utrecht, The Netherlands</p> <p>Mockenhaupt, Frank; Charité – University Medicine, Berlin, Institute of Tropical Medicine and International Health</p> <p>Schulze, Matthias; German Institute of Human Nutrition Potsdam-Rehbruecke</p> <p>Danquah, Ina; German Institute of Human Nutrition, Molecular Epidemiology; Charite Universitatsmedizin Berlin, Institute for Social Medicine, Epidemiology and Health Economy</p> <p>Spranger, Joachim; Department of Endocrinology and Metabolism, 1. Charité-University Medicine Berlin, Berlin, Germany.</p> <p>Bahendeka, Silver; St. Francis Hospital Nsambya,</p> <p>Agyemang, Charles; Academic Medical centre, University of Amsterdam, Department of Public Health</p>
Keywords:	Chronic Kidney Disease, Psychosocial stressors, migrants, rodam study, Europe, Ghana

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN PSYCHOSOCIAL STRESSORS WITH CHRONIC KIDNEY DISEASE AMONG MIGRANT AND NON-MIGRANT GHANAIS: THE RODAM STUDY

David N. Adjei, MSc, PhD^{1,2}; Karien Stronks, MSc, PhD¹; Dwomoa Adu, MD³; Erik Beune, MSc, PhD ¹; Karlijn Meeks, MSc, PhD ¹; Liam Smeeth, MD, PhD⁴ ; Juliet, Addo, MD, PhD ⁴; Ellis Owuso-Dabo, MSc, PhD ⁵, Kerstin Klipstein-Grobusch, MSc, PhD ^{6,7}; Frank P. Mockenhaupt, MD, PhD ⁸ ; Matthias B. Schulze, MSc, PhD ⁹; Ina, Danquah, MSc, PhD ^{9,10} ; Joachim, Spranger, MD, PhD ^{11,12,13}; Silver Bahendeka, MD, PhD¹⁴; Charles Agyemang, MPH, PHD¹

1. Department of Public Health, Academic Medical Center, University of Amsterdam, Amsterdam, Amsterdam Public Health Research Institute, Amsterdam, The Netherlands.
2. Department of Medical Laboratory Sciences, School of Biomedical and Allied Health Sciences, College of Health Sciences, University of Ghana, Accra, Ghana.
3. Department of Medicine, School of Medicine and Dentistry, University of Ghana and Korle-Bu Teaching Hospital, Accra, Ghana.
4. Department of Non-Communicable Disease Epidemiology, London School of Hygiene and Tropical Medicine, London, United Kingdom.
5. Kumasi Centre for collaborative Research, KNUST, Kumasi, Ghana.
6. Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Centre, Utrecht University, The Netherlands
7. Division of Epidemiology & Biostatistics, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa
8. Institute of Tropical Medicine and International Health, Charité -University Medicine Berlin, Augustenburger Platz 1, 13353 Berlin, Germany.

- 1
- 2
- 3
- 4 9. Department of Molecular Epidemiology, German Institute of Human Nutrition
- 5 Potsdam-Rehbrücke, Nuthetal, Germany.
- 6
- 7 10.Charité - Universitaetsmedizin Berlin, Institute for Social Medicine,
- 8 Epidemiology and Health Economics, Berlin, Germany.
- 9
- 10
- 11 11.Department of Endocrinology and Metabolism, Charité-University Medicine
- 12 Berlin, Berlin, Germany.
- 13
- 14
- 15 12.German Centre for Cardiovascular Research (DZHK), Berlin, Germany.
- 16
- 17 13.Center for Cardiovascular Research (CCR), Charité-University, Medicine,
- 18 Berlin, Germany.
- 19
- 20
- 21
- 22 14.MKPGMS - Uganda Martyrs University, Kampala, Uganda.
- 23
- 24
- 25
- 26
- 27

28 Address correspondence to David Nana Adjei, MSc, Department of Public
29 Health, Academic Medical Centre, University of Amsterdam, Meibergdreef 9,
30
31 1105 AZ Amsterdam, the Netherlands, School Biomedical and Allied Health
32
33 Sciences, Medical Laboratory Sciences, University of Ghana, E-mail:
34
35
36 dna@chs.edu.gh, d.n.adjei@amc.uva.nl, Tel: +233236717850
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54 **Abstract**
55
56
57
58
59
60

1
2
3
4
5 **Objectives:** The association between Psychosocial stressors (PS) and CKD
6 within sub-Saharan African (SSA) populations is unknown. We examined the
7 association between PS and CKD prevalence among rural and urban
8 Ghanaians and their migrants living in three European cities. We also assessed
9 if the influence of PS on CKD is partially mediated by primary risk factors
10 (hypertension and diabetes) of CKD.
11
12
13
14
15

16
17 **Methods:** A multi-centred cross sectional baseline data from the Research on
18 Obesity and Diabetes among African Migrants (RODAM) study. A random
19 sample of 5,659 adults (Europe, 3167, rural, 1,043, Urban Ghana, 1,449,
20 Ghana) aged 25 to 70 years. PS defined by negative life events, perceived
21 discrimination, perceived stress at work/home and depressive symptoms. Three
22 CKD outcomes were considered using the 2012 KDIGO (Kidney Disease:
23 Improving Global Outcomes) severity of CKD classification. Comparisons
24 between PS and CKD were made using logistic regression analyses across all
25 sites.
26
27
28
29
30
31
32

33
34 **Results:** We observed higher proportion of Ghanaians living in SSA with
35 negative life events (68.7%) and perceived permanent stress (15.9%).
36 Depressive symptoms (7.5%) and perceived discrimination (29.7%) were more
37 common among Ghanaians living in Europe. No association was observed
38 between either one of the four constructs of PS and CKD across all the sites
39 except for those with some level of stress at work/home in Berlin that had a
40 higher risk of CKD (2.78, 95% C.I. 1.43-5.43).
41
42
43
44
45
46

47 **Conclusion:** Our study shows no convincing evidence for associations between
48 stress as indicated by four PS constructs and prevalence of CKD. Further
49 studies aimed at identifying potential factors driving the high prevalence of CKD
50 among these populations are needed.
51
52
53
54
55
56
57
58
59
60

1
2
3 **Index Words:** Chronic kidney disease; psychosocial stressors; risk factor;
4 migrants; RODAM study, Europe, Ghana
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35

36 **Strengths and limitations of the study**

- 39 • This study used all three categories of CKD definitions (albuminuria,
40 reduced eGFR and CKD risk) by KDIGO 2012 in assessing association
41 of SS with CKD across all sites. This provided more detailed information
42 on CKD outcomes.
43
44
- 45 • All sites in our study used well standardized study protocols and this
46 eliminated intra protocol variability.
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- The use of four constructs of psychosocial stressors (negative life events, perceived discrimination, perceived stress at work/home and depressive symptoms) provided a robust approach to assessing SS associations with CKD.
 - The limitation of intra laboratory variability in earlier studies was eliminated using the same standard operating procedures in the same laboratory for running all samples for all sites.
 - PS is captured and experienced in different magnitude across different populations. We were unable to ascertain if PS as defined in this study was adequately captured among Ghanaians living in rural and urban Ghana.

Introduction

Worldwide, Chronic Kidney Disease (CKD) is a leading cause of mortality and morbidity with several risk factors (diabetes mellitus, obesity, hypertension and cardiovascular disease) (1). The epidemiologic transition in low-and-middle income countries (LMICs) shows increased burden of these risk factors (2-4). CKD's high morbidity and mortality is mostly driven by uncontrolled comorbidities such as diabetes and hypertension (5, 6). CKD treatment and management cost is very high and not sustainable even in high-income countries and this underscores the need for prevention (7). Available literature has shown that both individual and community level economic factors influence CKD (8-10). However, after adjusting for both individual and community level socioeconomic position, differences in CKD risk among different populations remained (8, 10, 11). These findings seem to suggest other social environmental factors may be driving CKD prevalence and progression in high-risk populations. Recent studies have shown that whereas Ghanaians living in Europe have a higher CKD risk compared to their host nation populations, they have a lower CKD risk compared with their peers living in urban Ghana (12). The increased risk of CKD observed in urban Ghana was not fully explained by conventional risk factors (12) and socio-economic status (13). This underscores the need to identify other modifiable risk factors of CKD for prevention, optimum treatment and efficient management.

1
2
3 Evidence shows that where an individual works or stays influences his or her
4 physiological wellbeing leading to an increased risk of chronic diseases (14, 15). Thus,
5 migrants' physiological wellbeing are influenced by the environment (host nations) they
6 move to stay. The association between PS and CKD as well as the biological
7 pathways through which PS influences CKD progression is poorly understood and
8 complex (5). Despite this, PS have been reported to be associated with alteration in
9 the sympathetic/autonomic nervous system activity leading to higher rates of traditional
10 risk factors of CKD including hypertension and diabetes (16, 17). A link between
11 stress, hypertension, diabetes and CKD through innervation of all segments of the
12 kidney by renal sympathetic nerves has been suggested (18). Also, environmental
13 stressors have been reported to contribute to the development of insulin resistance,
14 metabolic syndrome, obesity and diabetes which if uncontrolled leads to CKD incidence
15 (19, 20). Thus, the above-mentioned risk factors of CKD may explain the link between
16 PS and CKD.
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

35 However, studies linking psychosocial stressors (PS) to CKD prevalence and
36 progression vary greatly among different geographical populations. (5, 21-26).
37 Specifically, in the USA whereas no association was found between PS and CKD (26-
38 28) another study reported lower prevalence of CKD was associated with greater life
39 stressors at baseline (26). In contrast, in the Netherlands depressive and anxiety
40 symptoms were observed to be common among CKD patients and such patients had
41 increased risk of poor clinical outcomes (22). Similarly, a study conducted in Korea
42 reported a positive relationship between depressive symptoms and CKD (21). These
43 observations suggest differential impact of PS at different geographical locations. For
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 example, discrimination among migrants may differ greatly between host population and
4 from their SSA compatriots. Specifically, some studies have reported differences in PS
5 among rural and urban populations (29).
6
7
8
9

10 Current literature on the association between PS and CKD among sub-Saharan African
11 populations and their migrants in Europe is scanty and uncertain. We therefore sought
12 to determine the association between PS and CKD prevalence among Ghanaians in
13 rural and urban Ghana and their migrants living in three European cities. Furthermore,
14 we examined the influence of psychosocial stressors on risk factors (obesity, diabetes
15 and hypertension) of CKD.
16
17
18
19
20
21
22
23
24
25

26 **Methods**

27 *Study population and study design*

28
29
30 For this study, data from the Research on Obesity & Diabetes among African Migrants
31 (RODAM) study, a multi-centre cross sectional study, were used. The rationale,
32 conceptual framework, design and methodology of the RODAM study have been
33 described in detail elsewhere (12, 13, 30, 31). To summarize, the study was
34 conducted from 2012 to 2015. Ghanaians aged 25-70 years living in rural and urban
35 communities in Ghana as well as in three European cities (Amsterdam, Berlin and
36 London) were included in this study. We standardized data collection across all sites.
37
38 The ethics committees in Ghana, the Netherlands, Germany and the UK approved the
39 study protocol prior to data collection. Informed consent was obtained from each
40 participant prior to enrollment in the study. In Ghana, participants were randomly drawn
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 from a list of 30 enumeration areas in the Ashanti region based on the 2010
4 population census. These enumeration areas came from both rural areas and two
5 purposively selected urban cities (Kumasi and Obuasi). For Ghanaians in Amsterdam,
6 we randomly drew participants from the Municipal register. This register holds data on
7 country of birth of citizens and their parents, thus allowing for sampling based on the
8 Dutch standard indicator for ethnic origin. London lacked a population register for
9 migrant groups. Thus, Ghanaian organizations served as sampling frame for the study.
10 Lists of these organizations were obtained from the Ghanaian Embassy and the
11 Association of Ghanaian Churches in the UK in the boroughs known to have the
12 greatest concentration of Ghanaians. Members were selected from the lists of all
13 members of these organizations. In Berlin, the registration office of the federal state of
14 Berlin provided a list of Ghanaian individuals in Berlin but this resulted in low
15 response rate. Because of this, a change was made to use lists of Ghanaian churches
16 and organizations as the sampling frame. Across all sites in Europe, all selected
17 participants were sent a written invitation combined with written information (information
18 sheet) regarding the study and a response card. The participants were contacted by
19 phone to schedule a date and location of the interview with a trained research
20 assistant or opt for the self-administration of the paper questionnaire or digital online
21 version depending on the preference of the participant. After the completion of the
22 questionnaire, a date for physical examination was then scheduled after a positive
23 response. The participants were instructed to fast from 10.00 p.m. the night before the
24 physical examination. The response rate was 76% in rural Ghana and 74% in urban
25 Ghana. In London, of those individuals who were registered in the various Ghanaian
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 organizations and were invited, 75% agreed and participated in the study, while in
4
5 Berlin, this figure was 68%, and 53% in Amsterdam. For the current study,
6
7 5898 participants with data available on both questionnaire data and physical
8
9 measurements were used. Individuals who were outside the age range of 25-70 years
10
11 (n=239) were excluded because not all the study sites had individuals outside this age
12
13 range resulting in 5659 individuals comprising of 2492 from rural and urban Ghana
14
15 and 3167 from the three European cities. In the conduct of analysis, we further
16
17 excluded individuals with no data on CKD and all other indicators (n=52), resulting in
18
19 a data set of 5607 participants for analysis.
20
21
22
23
24
25

26 **Measurements**

27 28 29 **Covariates**

30 31 *Demographic and lifestyle factors*

32
33
34
35
36 For this study, we obtained information on demographics, educational level and lifestyle
37
38 factors (smoking and physical activity) by questionnaire. Physical examinations were
39
40 performed across all sites using validated devices per standardized operational
41
42 procedures. Weight was measured in light clothing and without shoes with SECA 877
43
44 scales to the nearest 0.1 kg. Height was measured without shoes with a portable
45
46 stadiometer (SECA 217) to the nearest 0.1 cm. Body mass index (BMI) was calculated
47
48 as weight (kg) divided by height squared (m²). Overweight was defined as BMI of 25
49
50 to < 30 kg/m² and obesity as BMI ≥30 kg/m². Waist circumference was measured in
51
52 centimetres at the midpoint between the lower rib and the upper margin of the iliac
53
54
55
56
57
58
59
60

1
2
3 crest. We used the same assessor for each participant in measuring all
4 anthropometrics and each was measured twice; the average of the two measurements
5 was used for analyses.
6
7
8
9

10 *Predictor: SS*

11
12 For this study, four constructs of psychosocial stress (discrimination, perceived stress
13 at work or at home, negative life events and depressive symptoms) were used as
14 explanatory variables.
15
16
17
18
19
20
21

22 *Perceived discrimination*

23
24 Everyday discrimination as perceived by participants was reported as routinely
25 experiencing instances of unfair treatment. We used the the Everyday Discrimination
26 Scale (EDS). The EDS comprises of a 9-items which rates the frequency at which
27 participants experience daily mistreatment and it focuses on being treated with less
28 courtesy or less respect, receiving poorer service than other people or being called
29 names or insulted. Participants had the option of rating each of the 9-items from
30 “never” = 1 to “very often” = 5. The obtained scores were summed and an average of
31 the scores was computed to obtain a final score of 1 to 5. This scale was used
32 because it is commonly used for self-reported discrimination (32), with consistent high
33 reliability among a variety of ethnicities (33), comprising African migrants in the
34 Netherland (34).
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

50 *Perceived stress at work or at home*

51
52 We defined perceived stress at work or at home as “sense of irritation, filled with
53 anxiety, or as having difficulties in sleeping because of circumstances at work or at
54
55
56
57
58
59
60

1
2
3 home". We used the psychological stress scale created by the INTERHEART study
4 (35). Participants in the study were asked about their opinion on frequency of stress at
5
6 (35). Participants in the study were asked about their opinion on frequency of stress at
7
8 work and at home, and could answer "never", "some periods", "several periods", or
9
10 "continually". Both answers were then combined into a composite score and graded
11
12 into four categories: never experienced to experienced permanent stress at home or at
13
14 work (35). Due to the very small numbers in the permanent periods of stress group,
15
16 we combined experienced several periods of stress at home or at work and permanent
17
18 periods of stress at home or at work.
19
20
21
22
23

24 ***Negative life events***

25
26 The presence of major negative life events among participants was perceived as any
27
28 event that could cause acute stress to an individual. We therefore applied the well-
29
30 validated and widely used List of Threatening Experiences (LTE) (36, 37). The scale
31
32 comprised of 12 unpleasant events participants perceived to have experienced in the
33
34 past 12 months. We used a slightly-altered version of LTE consisting of 9 unpleasant
35
36 items. We dichotomized participants into two groups namely "no negative life events"
37
38 and "one or more events" and participants in the second category were expected to
39
40 have higher levels of stress (37).
41
42
43
44
45

46 ***Depressive symptoms***

47
48 Depressive symptoms were measured by the 9-item Patient Health Questionnaire
49
50 (PHQ-9). The PHQ-9 consists of nine items, with a response scales 0 'not at all', 1
51
52 'on several days', 2 'on more than half of the days' and 3 'nearly every day'. A
53
54 participant was considered to be in a significant depressed mood (SDM) when one or
55
56
57
58
59
60

1
2
3 both of the items 1 (little interest or pleasure in doing things) and 2 (feeling down,
4 depressed, or hopeless) were answered with at least 'on more than half of the days',
5
6 and at least 5 of the 9 items were answered with at least 'on more than half of the
7
8 days'(38).
9
10
11
12

13 *Co-morbidity factors*

14
15
16 Blood pressure (BP) was measured three times using a validated semi-automated
17 device (The Microlife WatchBP home) with appropriate cuffs in a sitting position after
18 at least 5min rest. The mean of the last two BP measurements was used in the
19 analyses. Hypertension was defined as systolic BP 140mmHg and/or diastolic BP
20 90mmHg, and/or being on antihypertensive medication treatment, and/or self-reported
21 hypertension. Trained research assistants in all sites collected fasting venous blood
22 samples according to standard operation procedures, and then temporarily stored at
23 the local research location. The stored blood samples from the local research centres
24 were transported to Berlin, Germany, according to standardized procedures, for
25 biochemical analyses. This was done to avoid intra-laboratory variability. Fasting
26 plasma glucose concentration was measured using an enzymatic method (hexokinase).
27
28 We defined Type 2 diabetes according to the World Health Organization diagnostic
29 criteria (fasting glucose 7.0mmol/L, and/or current use of medication prescribed to treat
30 diabetes, and/or self-reported diabetes) (39). We assessed concentration of total
31 cholesterol using colorimetric test kits. All biochemical analyses were performed using
32 an ABX Pentra 400 Chemistry Analyzer (ABX Pentra; Horiba 90 ABX, Germany).
33
34 Hypercholesterolaemia was defined as total cholesterol level ≥ 6.22 mmol/L. Serum
35 creatinine concentration (in mol/L) was determined by a kinetic colorimetric
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 spectrophotometric isotope dilution mass spectrometry calibration method (Roche
4
5
6 Diagnostics).

7
8
9
10 **Outcome: CKD prevalence**

11
12 We asked participants to bring an early morning urine sample for the analyses of
13
14 albuminuria and creatinine levels. Urinary albumin concentration (in $\mu\text{mol/L}$) was
15
16 measured by an immunochemical turbidimetric method (Roche Diagnostics). Urinary
17
18 creatinine concentration (in mol/L) was measured by a kinetic spectrophotometric
19
20 method (Roche Diagnostics). Extensive quality checks were done inclusive of blinded
21
22 serial measurements. Estimated glomerular filtration rate (eGFR) was calculated using
23
24 the CKDEPI (CKD Epidemiology Collaboration) creatinine equation (40). Urinary
25
26 albumin-creatinine ratio (ACR; expressed in mg/mmol) was calculated by taking the
27
28 ratio between urinary albumin and urinary creatinine. eGFR and albuminuria were
29
30 categorized according to the 2012 KDIGO classification (41). eGFR was categorized as
31
32 follows: G1, 90mL/min/1.73m^2 (normal kidney function); G2, $60\text{-}89\text{mL/min/1.73m}^2$ (mildly
33
34 decreased); G3a, $45\text{-}59\text{mL/min/1.73m}^2$ (mildly to moderately decreased); G3b, 30-
35
36 44mL/min/1.73m^2 (moderately to severely decreased); G4, $15\text{-}29\text{ mL/min/1.73 m}^2$
37
38 (severely decreased); and G5, $<15\text{mL/min/1.73m}^2$ (kidney failure). Albuminuria
39
40 categories were derived from ACR and were as follows: A1, $< 3\text{mg/mmol}$ (normal to
41
42 mildly increased); A2, $3\text{-}30\text{mg/mmol}$ (moderately increased); and A3, $> 30\text{mg/mmol}$
43
44 (severely increased). CKD status was categorized according to severity of kidney
45
46 disease (green, low risk; yellow, moderately increased risk; orange, high risk; and red,
47
48 very high risk) using the combination of eGFR (G1-G5) and albuminuria (A1-A3) levels
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 defined by the 2012 KDIGO guideline (42). Due to the small number of participants in
4 the very high-risk category of CKD (n=27), the high and very high-risk groups were
5 combined. Because of the small number of participants in the severely increased
6 albuminuria category (A3, n=62), we defined albuminuria as ACR 3mg/ mmol by
7 combining the moderately increased (A2) and severely increased (A3) categories.
8
9
10
11
12
13

14
15
16
17 Covariates assessed were age, sex, educational level and length of stay in Europe,
18 hypertension and diabetes. Length of stay was assessed for Ghanaian migrants only.
19 Length of stay was defined as the number of years lived in Europe at the time of
20 data collection. Length of stay was controlled for due to evidence suggesting that it
21 influences mental health (43). Other covariates were hypertension, obesity and
22 diabetes.
23
24
25
26
27
28
29
30
31
32

33 ***Patient and Public Involvement***

34
35 Community leaders were involved in the recruitment of patients. These comprised of religious
36 communities (churches and mosques), endorsement from local key leaders and establishing relationships
37 with healthcare organizations. We also provided information on the study by involving the local media
38 (radio and television stations). We sent letters to all selected health and community authorities to notify
39 participants of the study. Team members were sent to the various communities to stay among the
40 community and organize mini clinics for a period of 1-2 weeks. Results of the study were disseminated
41 through seminars, durbars and via radio and television stations.
42
43
44
45
46

47 ***Statistical methods***

48
49 Characteristics of participants were expressed as absolute numbers and percentages
50 for categorical variables and means and standard deviations for continuous variables.
51
52
53
54 Odds ratios (ORs) and their corresponding 95% confidence intervals (CIs) and adjusted
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

CIs were estimated by means of binary logistic regression analyses to study odds of albuminuria (ACR>3 mg/mmol, A2-A3, moderately to severely increased albuminuria), reduced kidney function (eGFR< 60 mL/min/1.73m², G3-G5 moderately to severely decreased kidney function) and increased CKD risk (high and very high CKD risk), with adjustments for covariates (44). The Spearman's correlation test was used to test for associations between all four constructs of PS. Two models were used to examine the data. Model 1 was adjusted for age and sex, model 2 was adjusted for age and sex and educational level for Ghanaians living in SSA while age, sex, educational level and length of stay for Ghanaians living in Europe (45-47). Model 3 was adjusted for sex, age, educational level and conventional risk factors (hypertension, diabetes, hypercholesterolemia, BMI, physical activity and smoking status) of CKD. The analyses were performed for all 4 constructs of PS using individuals who have not experienced either of the PS per outcome as reference. All tests were stratified per sites, Ghanaians living in SSA and Europe; Ghanaians living in rural and urban Ghana and Ghanaians living in Amsterdam, Berlin and London due to an observed interaction between PS and site. Furthermore, the analysis were stratified for those with and without obesity, diabetes, hypertension across all sites. All analyses were performed using STATA, version 14.0 (StataCorp LP).

Results

Characteristics of the study population

Participants characteristics are shown in Table 1. Ghanaians living in Ghana were older than their peers living in Europe. There were more females compared with males

1
2
3 in both Ghana and Europe. Ghanaians living in Ghana were significantly less educated
4
5 than those living in Europe. Higher proportion of Ghanaians living in Ghana had
6
7 experienced negative life events in the last 12 months compared with their peers living
8
9 in Europe. More than half of Ghanaians living in Ghana had experienced some stress
10
11 at home or work whereas only a third of those living in Europe had experienced some
12
13 stress at home or work. Permanent stress at home/work was fairly the same among
14
15 Ghanaians living in SSA and Europe. Perceived discrimination was significantly higher
16
17 among Ghanaians living in Europe compared with their peers living in Ghana.
18
19 Depressive symptoms were more prevalent among Ghanaians living in Europe
20
21 compared with their peers living in Ghana. Almost all Ghanaians living in Europe were
22
23 first generation migrants. Ghanaians in Europe were more obese, more likely to smoke
24
25 and less physically active compared with their peers living in Ghana. Prevalence of
26
27 hypercholesterolemia was higher, but type 2 diabetes and hypertension were lower
28
29 among Ghanaians living in Ghana compared with their peers living in Europe.
30
31 Prevalence of albuminuria, reduced eGRF and CKD risk were higher in Ghanaians
32
33 living in Ghana compared with those living in Europe.
34
35
36
37
38
39
40
41
42
43
44
45
46

47 **Table 1: Baseline characteristics of respondents**
48

	Ghanaians (SSA) n (%)	Ghanaians (Europe) n (%)	p-value
N	2,492 (44.1)	3,167 (55.9)	

			0.001*
Female sex	1672 (67.1)	1,851 (58.5)	0.001*
Age (years)	45.7±11.9	46.6±9.9	0.006*
Educational status			
Low	1169 (49.2)	635 (21.8)	0.001*
Middle	858 (36.1)	1111 (38.1)	0.122
High	347 (14.6)	1168 (40.1)	0.001*
Negative life events in the past 12 months			
No	739 (31.3)	1158 (41.0)	0.001*
Yes	1619 (68.7)	1667 (59.0)	0.001*
Perceived stress at home/work			
Never	692 (29.4)	1371 (48.8)	0.001*
Some periods	1290 (54.7)	1033 (36.8)	0.001*
Several/Permanent	375 (15.9)	407 (14.4)	0.117
Perceived discrimination			
No	2065 (95.2)	1960 (70.3)	0.001*
Yes	104 (4.8)	829 (29.7)	0.001*
Depressive symptoms			
No	2239 (94.9)	2582 (92.5)	0.001*
Yes	119 (5.1)	209 (7.5)	0.001*
Migration generation			
First	Not applicable	2868 (98.7)	Not applicable
Second	Not applicable	38 (1.3)	Not applicable

BMI			
Normal (<25kg/m ²)	1373 (55.2)	643 (20.4)	0.001*
Overweight (25 ≤ 30kg/m ²)	684 (27.5)	1,350 (42.8)	0.001*
Obese (>30kg/m ²)	432 (17.3)	1163 (36.8)	0.001*
Currently smoking	36 (1.5)	121 (4.1)	0.001*
Physical activity	1255 (52.8)	1131 (44.0)	0.001*
Hypocholesteraemia	352 (14.2)	354 (11.3)	0.007*
Type 2 diabetes	206 (8.3)	444 (14.0)	0.001*
Hypertension	837 (33.6)	1801 (56.9)	0.001*
ACR			
A1 < 3mg/mmol	2215 (90.2)	2814 (91.8)	0.001*
A2-A ≥ 3mg/mmol	243 (9.8)	252 (8.2)	0.285
eGFR			
G1-G2 ≥ 60 mL/min/1.73 m ²	2377 (96.3)	2936 (97.4)	0.018*
G3a-G5 < 60 mL/min/1.73 m ²	85 (3.7)	78 (2.6)	0.018*
CKD Risk			
Low risk	2197 (89.6)	2705 (91.5)	0.015*
Moderate-very high risk	256 (10.4)	252 (8.5)	0.015*

Abbreviations: N, number of respondents; BMI, body mass index; eGFR, estimated glomerular filtration rate; G1-G2, normal to high kidney function to mildly decreased; G3a-G5, mildly to moderately decreased to Kidney failure; ACR, albumin creatinine ratio; A1, normal to mildly increased; A2-A3, moderately increased to severely increased; CKD, Chronic kidney disease; SSA, Sub-Saharan Africa; CI, confidence intervals.

Association between PS and CKD

Figure 1-4 shows CKD prevalence by negative life events in the past 12 months among Ghanaians living in Ghana and Europe. In Europe, CKD prevalence was fairly the same among those who had experienced any negative life events compared with those who had not in the last 12 months. Prevalence of CKD was higher among Ghanaians who had not experienced any negative life events in the past 12 months compared with those who had experienced some negative life events and living in Ghana. CKD prevalence was higher among Ghanaians who had not experienced any form of discrimination than those who had not in Ghana as well as in Europe (Figure 2). CKD prevalence was higher among Ghanaians who had experienced several/permanent stress at work/home in the past 12 months and living in Ghana or Europe (Figure 3). Ghanaians who did not report any form of depressive symptoms

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

had a higher CKD prevalence than those who did and living in Ghana and Europe (Figure 4).

For peer review only

Table 2 shows the correlation matrix between the 4 constructs of PS among Ghanaians living in Ghana and those living in Europe. All four constructs of PS were positively correlated with each other among Ghanaians living in Europe and Ghanaians living in Ghana, except stress at work/home and discrimination among Ghanaians living in Ghana.

Table 2: Relationship between PS constructs (negative life events, discrimination, stress at work or home and depression) by Ghanaians (SSA) and Ghanaians (Europe)

Correlation matrix	Negative events	Discrimination	Stress at work/home	Depression
Europe				
Negative events	1.000			
Discrimination	0.152**	1.000		
Stress at work/home	0.297**	0.161**	1.000	
Depressive symptoms	0.143**	0.1366**	0.285**	1.000
Ghana				
Negative events	1.000			
Discrimination	0.079**	1.000		

1				
2				
3				
4	Stress at			
5				
6	work/home	0.101**	-0.032	1.000
7				
8	Depressive			1.000
9				
10	symptoms	0.091**	0.042	0.185**
11				
12				

****Significant at 1%, Spearman's correlation**

For peer review only

Table 3 shows association between all 4 constructs of PS and CKD among Ghanaians living in Ghana and those living in Europe. There was no statistically significant association between PS and albuminuria, reduced eGFR and CKD risk among Ghanaians living in Ghana and those living in Europe except individuals living in Europe with some stress and lower risk of reduced eGFR. Table S1 shows further

1
2
3 adjustments for conventional risk factors of CKD. This did show any
4
5 associations between PS and albuminuria, reduced eGFR and CKD risk among
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

adjustments for conventional risk factors of CKD. This did show any associations between PS and albuminuria, reduced eGFR and CKD risk among Ghanaians living in Ghana and Europe (S1). Table S2 shows further stratification based on obesity status. We did not find any association between PS and CKD for obese participants and those who were not obese for Ghanaians living in rural and urban Ghana and those living in Europe. However, we observed an inverse association between PS and CKD among migrants who were not obese but have experienced discrimination for the past 12 months (S2). In Table S3 we stratified our analysis based on diabetic status. We did not find any associations between PS and CKD for participants with and without diabetes for both Ghanaians living in rural and urban Ghana and their migrant peers in Europe (S3). Finally, Table S4 stratified analysis by hypertension status. No associations were observed between PS and CKD for individuals who had hypertension and those who did not have hypertension for both those living in rural and urban Ghana as well as their compatriots living in Europe. An inverse association was observed between PS and CKD among Ghanaians who have experienced discrimination in the last 12 months with no hypertension and living in Europe. Also, we observed that having experienced some stress at home/work was inversely associated with reduced eGFR among Ghanaians with hypertension and living in Europe (S4).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

Table 3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe									
No	1128 (8.2)	1.00 (Reference)	1.00 (Reference)	1106 (2.6)	1.00 (Reference)	1.00 (Reference)	1090 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	1615 (8.4)	1.03 (0.78-1.35)	1.07 (0.80-1.42)	1587 (2.5)	0.86 (0.53-1.42)	0.83 (0.49-1.39)	1557 (8.6)	0.97 (0.76-1.32)	0.99 (0.74-1.32)
Ghana									
No	732 (8.7)	1.00 (Reference)	1.00 (Reference)	736 (4.5)	1.00 (Reference)	1.00 (Reference)	732 (10.9)	1.00 (Reference)	1.00 (Reference)
Yes	1595 (3.8)	0.87 (0.65-1.16)	0.85 (0.63-1.14)	1601 (3.4)	0.69 (0.45-1.08)	0.67 (0.44-1.09)	1590 (9.9)	0.88 (0.66-1.17)	0.86 (0.64-1.15)
Discrimination									
Europe									
No	1899 (8.5)	1.00 (Reference)	1.00 (Reference)	1867 (2.6)	1.00 (Reference)	1.00 (Reference)	1832 (8.9)	1.00 (Reference)	1.00 (Reference)

1										
2										
3										
4	Yes	810 (7.4)	0.87 (0.64-1.19)	0.92 (0.67-1.26)	791 (2.2)	0.83 (0.47-1.47)	0.84 (0.46-1.52)	782 (7.3)	0.82 (0.59-1.12)	0.84 (0.60-1.16)
5										
6	Ghana									
7										
8	No	2034 (10.0)	1.00 (Reference)	1.00 (Reference)	2047 (3.9)	1.00 (Reference)	1.00 (Reference)	2031 (10.6)	1.00 (Reference)	1.00 (Reference)
9										
10										
11	Yes	104 (7.7)	0.83 (0.39-1.73)	0.91 (0.67-1.24)	104 (1.9)	0.67 (0.15-2.85)	0.67 (0.16-2.84)	104 (6.7)	0.70 (0.32-1.55)	0.71 (0.32-1.55)
12										
13										
14	Stress at home/work									
15										
16	Europe									
17										
18	Never	1330 (8.2)	1.00 (Reference)	1.00 (Reference)	1305 (3.4)	1.00 (Reference)	1.00 (Reference)	1282 (8.5)	1.00 (Reference)	1.00 (Reference)
19										
20	Some stress	1002 (7.9)	0.97 (0.72-1.31)	1.04 (0.76-1.42)	984 (1.4)	0.47 (0.26-0.87)	0.46 (0.24-0.88)	968 (8.6)	0.96 (0.71-1.30)	1.02 (0.74-1.39)
21										
22	Several/Permanent stresses	397 (9.1)	1.11 (0.74-1.64)	1.153 (0.77-1.72)	390 (2.3)	0.73 (0.35-1.52)	0.76 (0.36-1.61)	383 (9.7)	1.13 (0.77-1.68)	1.19 (0.80-1.79)
23										
24	Ghana									
25										
26	Never	682 (10.3)	1.00 (Reference)	1.00 (Reference)	688 (3.3)	1.00 (Reference)	1.00 (Reference)	682 (9.9)	1.00 (Reference)	1.00 (Reference)
27										
28	Some stress	1279 (9.5)	0.87 (0.64-1.19)	0.80 (0.59-1.11)	1279 (3.9)	1.06 (0.63-1.77)	1.11 (0.66-1.87)	1274 (10.3)	0.95 (0.69-1.30)	0.92 (0.67-1.26)
29										
30	Several/Permanent stresses	365 (8.5)	0.75 (0.48-1.18)	0.68 (0.59-1.11)	369 (4.1)	1.13 (0.57-2.23)	1.22 (0.61-2.46)	365 (10.4)	0.96 (0.63-1.47)	0.92 (0.59-1.42)
31										
32										
33	Depressive symptoms									
34										
35	Europe									
36										
37	No	2505	1.00	1.00	2457	1.00	1.00	2416	1.00	1.00
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										

	(8.5)	(Reference)	(Reference)	(2.7)	(Reference)	(Reference)	(8.7)	(Reference)	(Reference)
Yes	206 (6.3)	0.71 (0.39-1.27)	0.76 (0.43-1.36)	202 (1.5)	0.63 (0.19-2.03)	0.68 (0.21-2.23)	199 (7.1)	0.78 (0.44-1.37)	0.83 (0.47-1.46)
Ghana									
No	2212 (9.9)	1.00 (Reference)	1.00 (Reference)	2222 (3.8)	1.00 (Reference)	1.00 (Reference)	2207 (10.4)	1.00 (Reference)	1.00 (Reference)
Yes	114 (5.3)	0.45 (0.19-1.03)	0.45 (0.19-1.01)	114 (2.6)	0.52 (0.16-1.72)	0.53 (0.17-1.74)	114 (7.9)	0.62 (0.30-1.25)	0.61 (0.30-1.24)

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe

1
2
3 Table 4 shows associations between all 4 constructs of PS and CKD stratified
4 by Ghanaians living in urban and rural Ghana. There was no association
5
6 between PS and albuminuria, reduced eGFR and CKD risk among Ghanaians
7
8 living rural and urban Ghana.
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depressive symptoms) with albuminuria, reduced eGFR and CKD risk among rural and urban Ghana

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Urban Ghana									
No	477 (11.9)	1.00 (Reference)	1.00 (Reference)	477 (4.4)	1.00 (Reference)	1.00 (Reference)	477 (12.2)	1.00 (Reference)	1.00 (Reference)
Yes	912 (10.5)	0.87 (0.61-1.23)	0.87 (0.61-1.24)	911 (3.4)	0.73 (0.41-1.31)	0.72 (0.40-1.29)	910 (10.8)	0.87 (0.61-1.24)	0.87 (0.61-1.25)
Rural Ghana									
No	255 (7.5)	1.00 (Reference)	1.00 (Reference)	259 (4.6)	1.00 (Reference)	1.00 (Reference)	255 (8.6)	1.00 (Reference)	1.00 (Reference)
Yes	683 (7.6)	0.97 (0.55-1.69)	0.94 (0.54-1.64)	690 (3.5)	0.63 (0.31-1.31)	0.66 (0.32-1.37)	680 (8.8)	0.93 (0.55-1.58)	0.92 (0.54-1.56)
Discrimination									
Urban Ghana									
No	1326 (11.1)	1.00 (Reference)	1.00 (Reference)	1326 (3.9)	1.00 (Reference)	1.00 (Reference)	1325 (11.4)	1.00 (Reference)	1.00 (Reference)

1										
2										
3										
4	Yes	71 (8.5)	0.85 (0.36- 2.00)	0.89 (0.37- 2.11)	71 (2.8)	1.17 (0.27- 2.09)	1.16 (0.27- 2.06)	71 (7.1)	0.69 (0.27- 1.77)	0.72 (0.28-1.83)
5										
6	Rural Ghana									
7										
8	No	708 (8.1)	1.00 (Reference)	1.00 (Reference)	721 (3.9)	1.00 (Reference)	1.00 (Reference)	706 (9.2)	1.00 (Reference)	1.00 (Reference)
9										
10	Yes	33 (6.1)	0.79 (0.18- 3.47)	0.84 (0.19- 2.65)	33 (0.0)	***	***	33 (6.1)	0.75 (0.17- 2.89)	0.83 (0.19-2.65)
11										
12										
13	Stress at									
14	home/work									
15										
16	Urban Ghana									
17										
18	Never	460 (10.9)	1.00 (Reference)	1.00 (Reference)	460 (3.3)	1.00 (Reference)	1.00 (Reference)	460 (10.2)	1.00 (Reference)	1.00 (Reference)
19										
20	Some stress	732 (11.5)	1.04 (0.71- 1.51)	0.91 (0.62- 1.37)	730 (4.1)	1.27 (0.66- 2.43)	1.30 (0.67- 2.51)	730 (11.8)	1.13 (0.77- 1.65)	1.04 (0.71-1.53)
21										
22	Several/Perman ent stresses	197 (9.6)	0.87 (0.50- 1.52)	0.74 (0.42- 1.02)	198 (3.5)	1.17 (0.46- 2.84)	1.20 (0.47- 3.09)	197 (11.7)	1.15 (0.68- 1.71)	1.05 (0.61-1.81)
23										
24	Rural Ghana									
25										
26	Never	222 (9.0)	1.00 (Reference)	1.00 (Reference)	228 (3.5)	1.00 (Reference)	1.00 (Reference)	222 (9.5)	1.00 (Reference)	1.00 (Reference)
27										
28	Some stress	547 (6.9)	0.69 (0.39- 1.23)	0.68 (0.38- 1.22)	549 (3.6)	0.88 (0.38- 2.07)	0.92 (0.39- 2.18)	544 (8.3)	0.74 (0.42- 1.30)	0.75 (0.42-1.31)
29										
30	Several/Perman ent stresses	168 (7.1)	0.63 (0.30- 1.37)	0.60 (0.28- 1.29)	171 (4.7)	1.07(0.38- 3.03)	1.21(0.43- 3.46)	168 (8.9)	0.71 (0.34- 1.50)	0.73 (0.35-1.50)
31										
32										
33	Depressive									
34	symptoms									
35										
36	Urban Ghana									
37										
38	No	1336	1.00	1.00	1335	1.00	1.00	1334	1.00	1.00
39										
40										
41										
42										
43										
44										
45										
46										
47										

	(11.3)	(Reference)	(Reference)	(3.8)	(Reference)	(Reference)	(11.5)	(Reference)	(Reference)
Yes	52 (3.9)	0.30 (0.07-1.25)	0.30 (0.07-1.27)	52 (1.9)	0.46 (0.06-2.50)	0.45 (0.06-2.13)	52 (5.8)	0.44 (0.14-1.45)	0.45 (0.14-1.48)
Rural Ghana									
No	876 (7.7)	1.00 (Reference)	1.00 (Reference)	887 (3.8)	1.00 (Reference)	1.00 (Reference)	873 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	62 (6.5)	0.67 (0.23-1.94)	0.67 (0.23-1.94)	62 (3.2)	0.58 (0.13-2.56)	0.61 (0.14-2.68)	62 (9.7)	0.82 (0.33-2.01)	0.85 (0.34-2.09)

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in urban and rural Ghana among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in rural and urban Ghana. ***; no case of CKD and therefore odds ratios were not calculated

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

For peer review only

1
2
3 Table 5 shows associations between all 4 constructs of PS and CKD stratified by
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 5 shows associations between all 4 constructs of PS and CKD stratified by
Ghanaians living in Amsterdam, Berlin and London. There was no association between
PS and albuminuria, reduced eGFR and CKD risk among Ghanaians living Amsterdam,
Berlin and London except for positive association between stress at work/home and
albuminuria and CKD risk among Ghanaians living in Berlin.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Table 5: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depressive symptoms) with albuminuria, reduced eGFR and CKD risk among Ghanaians in three European cities.

	Albuminuria (ACR ≥ 3 mg/mmol)			eGFR < 60 mL/min/1.73 m2			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Amsterdam									
No	548 (7.3)	1.00 (Reference)	1.00 (Reference)	534 (2.4)	1.00 (Reference)	1.00 (Reference)	521 (7.5)	1.00 (Reference)	1.00 (Reference)
Yes	784 (7.8)	1.08 (0.71-1.63)	1.18 (0.77-1.81)	764 (2.9)	1.11 (0.55-2.23)	1.15 (0.55-2.37)	742 (8.0)	1.06 (0.69-1.62)	1.08 (0.71-1.66)
Berlin									
No	213 (9.9)	1.00 (Reference)	1.00 (Reference)	213 (2.4)	1.00 (Reference)	1.00 (Reference)	213 (10.8)	1.00 (Reference)	1.00 (Reference)
Yes	329 (10.9)	1.12 (0.63-1.99)	1.19 (0.67-2.15)	330 (1.8)	0.64 (0.19-2.17)	0.61 (0.18-2.11)	329 (9.4)	0.86 (0.48-1.52)	0.91 (0.51-1.63)
London									
No	367 (8.7)	1.00 (Reference)	1.00 (Reference)	359 (3.1)	1.00 (Reference)	1.00 (Reference)	356 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	502 (7.8)	0.89 (0.55-1.44)	0.83 (0.49-1.41)	493	0.68 (0.28-1.68)	0.58 (0.22-1.48)	486 (9.1)	1.04 (0.64-1.68)	0.99 (0.58-1.68)

		1.46)	1.41)	(2.2)	1.65)	1.51)		1.68)	
Discrimination									
Amsterdam									
No	956 (8.3)	1.00 (Reference)	1.00 (Reference)	935 (2.9)	1.00 (Reference)	1.00 (Reference)	909 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	363 (5.0)	0.59 (0.34- 1.00)	0.59 (0.35- 1.02)	349 (2.1)	0.69 (0.30- 1.62)	0.81 (0.34- 1.91)	342 (5.9)	0.69 (0.41- 1.14)	0.69 (0.41-1.16)
Berlin									
No	329(10.0)	1.00 (Reference)	1.00 (Reference)	329 (2.1)	1.00 (Reference)	1.00 (Reference)	329 (10.3)	1.00 (Reference)	1.00 (Reference)
Yes	209 (11.0)	1.11 (0.63- 1.95)	1.16 (0.65- 2.05)	210 (1.9)	0.83 (0.24- 2.93)	0.82 (0.23- 2.91)	209 (9.1)	0.86 (0.48- 1.56)	0.89 (0.49-1.63)
London									
No	614 (7.9)	1.00 (Reference)	1.00 (Reference)	603 (2.5)	1.00 (Reference)	1.00 (Reference)	594 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	238 (7.9)	1.03 (0.59- 1.81)	1.18 (0.65- 2.15)	232 (2.6)	1.29 (0.46- 3.59)	1.09 (0.35- 3.43)	231 (7.8)	0.93 (0.53- 1.63)	0.98 (0.52-1.82)
Stress at home/work									
Amsterdam									
Never	634 (8.4)	1.00 (Reference)	1.00 (Reference)	622 (3.2)	1.00 (Reference)	1.00 (Reference)	603 (8.0)	1.00 (Reference)	1.00 (Reference)
Some stress	478 (5.7)	0.68 (0.42- 1.11)	0.69 (0.42- 1.13)	462 (1.9)	0.64 (0.29- 1.43)	0.68 (0.30- 1.52)	452 (6.0)	0.74 (0.45- 1.20)	0.74 (0.45-1.22)
Several/Permanent stresses	210 (9.1)	1.09 (0.63- 1.91)	1.12 (0.64- 1.95)	204 (2.5)	0.71 (0.26- 1.95)	0.77 (0.28- 2.14)	198 (10.1)	1.24 (0.71- 2.14)	1.26 (0.73-2.20)

1										
2										
3										
4	Berlin									
5		250	1.00	1.00	250	1.00	1.00	1.00	1.00	
6	Never	(9.0)	(Reference)	(Reference)	(2.0)	(Reference)	(Reference)	250 (6.4)	(Reference) (Reference)	
7										
8										
9	Some stress	196	2.50 (1.33-	2.81 (1.46-	197	0.88 (0.20-	0.83 (0.19-		2.57 (1.34-	2.78 (1.43-5.43)
10		(15.3)	4.71)	5.40)	(1.5)	3.79)	3.62)	196 (14.8)	4.90)	
11										
12										
13	Several/Perman									
14	ent stresses		1.64 (0.72-	1.69 (0.73-	197	2.10 (0.47-	2.04 (0.44-		1.52 (0.65-	1.58 (0.66-3.75)
15		96 (10.4)	3.73)	3.91)	(3.1)	9.46)	9.26)	76 (9.4)	3.58)	
16										
17										
18	London									
19			1.00	1.00	433	1.00	1.00		1.00	1.00
20	Never	446 (9.2)	(Reference)	(Reference)	(4.4)	(Reference)	(Reference)	429 (10.5)	(Reference)	(Reference)
21										
22	Some stress	328 (7.0)	0.73 (0.43-	0.79 (0.44-	325	0.17 (0.04-	0.09 (0.01-		0.65 (0.38-	0.66 (0.37-1.19)
23			1.25)	1.40)	(0.6)	0.73)	0.67)	320 (6.9)	1.10)	
24										
25	Several/perman	91 (7.7)	0.81 (0.35-	0.86 (0.35-	90 (1.1)	0.27 (0.03-	0.24 (0.03-		0.83 (0.38-	0.92 (0.39-2.16)
26	ent stresses		1.87)	2.14)		2.12)	2.05)	74 (8.9)	1.83)	
27										
28	Depressive									
29	symptoms									
30										
31	Amsterdam									
32		1199	1.00	1.00	1135	1.00	1.00		1.00	1.00
33	No	(7.8)	(Reference)	(Reference)	(2.8)	(Reference)	(Reference)	1135 (7.9)	(Reference)	(Reference)
34										
35	Yes	121 (6.6)	0.81 (0.39-	0.83 (0.39-	118	0.65 (0.15-	0.71 (0.16-		0.83 (0.39-	0.82 (0.38-1.74)
36			1.72)	1.76)	(1.7)	2.77)	3.06)	116 (6.9)	1.76)	
37										
38	Berlin									
39			1.00	1.00	504	1.00	1.00		1.00	1.00
40	No	503 (10.7)	(Reference)	(Reference)	(2.2)	(Reference)	(Reference)	503 (10.1)	(Reference)	(Reference)
41										
42										
43										
44										
45										
46										
47										

1										
2										
3										
4	Yes	34 (5.9)	0.53 (0.12-2.27)	0.49 (0.11-2.13)	34 (0.0)	***	***	34 (5.9)	0.55 (0.13-2.37)	0.52 (0.12-2.24)
5										
6	London									
7										
8	No	803 (8.3)	1.00 (Reference)	1.00 (Reference)	785 (2.6)	1.00 (Reference)	1.00 (Reference)	778 (8.9)	1.00 (Reference)	1.00 (Reference)
9										
10										
11	Yes	51 (5.9)	0.67 (0.20-2.21)	0.91 (0.27-3.07)	50 (2.0)	0.91 (0.11-7.43)	1.15 (0.14-9.54)	49 (8.2)	0.94 (0.33-2.69)	1.30 (0.44-3.81)
12										

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, educational level and length of stay; Abbreviations: CI, confidence interval; ACR, albumin creatinine ratio; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Amsterdam, Berlin and London among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Europe ***; no case of CKD and therefore odds ratios were not calculated.

Peer review only

Discussion

Key findings

Whereas there was an association between those who have experienced some stress at home/work and reduced eGFR among Ghanaians living in Europe, we did not find any association between PS and CKD among Ghanaians living in rural and urban Ghana and their peers in Europe. Also, PS was not associated with CKD for those living in rural and urban Ghana and neither for those living in the three European cities. However, there was an association between stress at work/home and albuminuria and CKD risk among Ghanaians living in Berlin. Further adjustment for conventional risk factors of CKD yielded similar results.

Discussion of key findings

Association between PS and CKD in Ghana

Our study did not find any association between any of the four constructs of PS and prevalence of CKD (albuminuria, reduced eGFR and CKD risk) among Ghanaians living in rural and urban Ghana. Our findings are however in contrast with earlier studies which reported positive associations between PS and prevalent of CKD (22, 26, 48). Other studies have hypothesised that the influence of PS on CKD may be important in only those with hypertension and diabetes and that PS may mediate or moderate the association between renal functioning and lifestyle behaviours such as smoking and physical activity (28). For example, they argue that stress enhances

1
2
3 Sympathetic Nervous System (SNS) activity to increase glucocorticoid secretion and
4
5
6 inflammatory cytokines, which heavily contribute to hypertension, diabetes and vascular
7
8 disease which are major risk factors of CKD incidence and prevalence (49). We did
9
10 not find any literature on the association between PS and CKD prevalence in rural and
11
12 urban populations. Worth noting, however, is the presence of rich family support
13
14 systems in the Ghanaian context especially in rural Ghana which may help individuals
15
16 with CKD to cope with PS thereby minimizing its effect. For example, patients with
17
18 limited social networks and low social support have been shown to have augmented
19
20 risk of morbidity and mortality (50-52). Specifically, there is evidence that positive
21
22 social support is a protective factor for persons dealing with long-term disease
23
24 conditions (53). Other studies have reported a protective relationship between social
25
26 networks, emotionally supportive relationship and threats to physiological and
27
28 psychosocial health (54).
29
30
31
32
33
34
35
36
37
38

39 **Association between PS and CKD Amsterdam, Berlin and London**

40
41
42 Literature on the association between PS and CKD prevalence among migrants is
43
44 scant and absent in most European populations. The lack of positive association
45
46 between PS and CKD in our study is consistent with recent studies conducted among
47
48 African Americans (26, 28) and other populations (27, 55). Specifically, a recent study
49
50 using data from the Jackson Heart Study which comprised of extensive constructs of
51
52 psychosocial variables reported that greater life stressors were associated with lower
53
54 prevalence of CKD at baseline (26). Several studies in other parts of the world have
55
56
57
58

1
2
3 reported a positive relationship between higher prevalence of stressors and CKD risk
4
5 (21, 22), although study findings have been inconsistent. Whereas some did not find
6
7 any associations among African Americans (26) others found associations in other
8
9 populations. Even among those who found some associations the directions differed
10
11 (22). Reasons for the lack of association observed in our study among migrants are
12
13 not fully understood but this lack of association may be a reflection of the real world.
14
15 First, migrants from Ghana practice both nuclear and extended family support system
16
17 as their peers living in rural and urban, this practice may mitigate the impact of
18
19 stressors such as unemployment, death of a love one, discrimination, etc. They also
20
21 belong to several religious organisations such as churches, which provide similar
22
23 support systems against stressors. Moreover, there are several associations of the
24
25 various ethnic groups (Akan, Ga and Ewe) providing such support when the need
26
27 arises. These systems provide both instrumental and/or emotional social support (56).
28
29 These assertions are supported by several studies. Specifically, these studies have
30
31 shown that social support positively affect outcomes through mechanisms such as
32
33 increased patient compliance with therapies, decreased levels of depressive affect,
34
35 direct physiologic effects on the immune system and improved perception of quality of
36
37 life (53, 54).
38
39
40
41
42
43
44
45
46
47

48 **Strength and limitation**

49
50
51 Our study is the first to use all four robust constructs of PS to determine association
52
53 between PS and CKD. This gave our study a more robust definition of PS compared
54
55 to other similar studies. The use of all three definitions of CKD per KDIGO guidelines
56
57
58
59

1
2
3 also provided a broader definition of CKD and allowed comparison between different
4
5 geographical regions. The use of a homogenous population of Ghanaians and
6
7 standardized protocols and diagnostic criteria in this study also provided a novel
8
9 opportunity to compare Ghanaians living in rural and urban Ghana and their
10
11 compatriots living in Europe. There are limitations to our study. First, the use of cross-
12
13 sectional design prevented us from determining the longitudinal effect of repeated
14
15 exposure to PS among the two populations. PS is captured and experienced in
16
17 different magnitude across different populations. We were unable to ascertain if PS as
18
19 defined in this study was adequately captured among Ghanaians living in rural and
20
21 urban Ghana.
22
23
24
25
26
27

28 **Conclusion**

29
30
31 Generally, our study shows no associations between stress as indicated by four PS
32
33 indicators and prevalence of CKD. Consequently, there is the need to explore other
34
35 factors that may be responsible for the observed differences in the prevalence of CKD
36
37 among Ghanaians living in rural and urban Ghana and their peers living in Europe.
38
39

40 **Acknowledgement**

41
42 The authors are very grateful to the research assistants, interviewers and other staff of
43
44 the five research locations who took part in gathering the data and the Ghanaian
45
46 volunteers in all the participating RODAM sites. We gratefully acknowledge the
47
48 advisory board members for their valuable support in shaping the RODAM study
49
50 methods and the Academic Medical Centre Biobank for their support in biobank
51
52 management and high-quality storage of collected samples.
53
54
55
56
57
58
59
60

Contributors

My co-authors have all contributed substantially to this manuscript and approve of this submission. Research idea and study design: DNA, CA, KS, DA, EB, KM, JA; data acquisition and curation: DNA, CA, EB, KM, data analysis/interpretation: DNA, CA, KS, DA, EB, KM, LS, JA, EOD, KKG, FPM, ID, JS, SB, ADA; statistical analysis: DNA, CA, KS. DNA, CA, KS, DA, EB, KM, LS, JA, EOD, KKG, FPM, ID, JS, SB, ADA contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved. DNA and CA takes responsibility that this study has been reported honestly, accurately, and transparently; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Funding

This work was supported by the European Commission under the Framework Programme (Grant Number: 278901). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The

1
2
3 Wellcome Trust supported Professor Smeeth's contribution, grant number WT082178.
4
5

6 Professor Joachim Spranger was supported by the DZHK (German Center for
7
8 cardiovascular research) and the Berlin Institute of Health (BIH).
9
10
11
12

13 **Competing interest:** I have communicated with all my co-authors and obtained
14 their full disclosures. My co-authors and I declare no conflicts of interest.
15
16

17
18
19 **Patient Consent:** None declared
20
21

22 **Ethics approval:** IRBs at each participating site.
23
24

25
26 **Data sharing statement:** Data are available from the RODAM research cohort,
27 a third party. Dr. Eric Beune affiliated with the RODAM research cohort and a
28 co-author of this paper in accordance with the RODAM requirements for
29 collaboration. Dr. Beune is the Data Collection Coordinator of RODAM and may
30 be contacted with further questions (e.j.beune@amc.uva.nl). Additionally,
31 researchers interested in further collaboration with RODAM may see the
32 following URL: <http://www.rod-am.eu/>
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

References

1. Weisbord SD. Symptoms and their correlates in chronic kidney disease. *Adv Chronic Kidney Dis.* 2007;14(4):319-27.
2. Correa-Rotter R, Naicker S, Katz IJ, Agarwal SK, Valdes RH, Kaseje D, et al. Demographic and epidemiologic transition in the developing world: role of albuminuria in the early diagnosis and prevention of renal and cardiovascular disease. *Kidney Int.* 2004;66:S32-S7.
3. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet.* 2012;380(9859):2095-128.

4. Katz IJ, Gerntholtz T, Naicker S. Africa and nephrology: the forgotten continent. *Nephron Clinical Practice*. 2011;117(4):320-7.
5. Bruce MA, Beech BM, Sims M, Brown TN, Wyatt SB, Taylor HA, et al. Social environmental stressors, psychological factors, and kidney disease. *J Investig Med*. 2009;57(4):583-9.
6. Osafo C, Mate-Kole M, Affram K, Adu D. Prevalence of chronic kidney disease in hypertensive patients in Ghana. *Ren Fail*. 2011;33(4):388-92.
7. Ojo A. Addressing the global burden of chronic kidney disease through clinical and translational research. *Trans Am Clin Climatol Assoc*. 2014;125:229.
8. Norris K, Nissenson AR. Race, gender, and socioeconomic disparities in CKD in the United States. *J Am Soc Nephrol*. 2008;19(7):1261-70.
9. Volkova N, McClellan W, Klein M, Flanders D, Kleinbaum D, Soucie JM, et al. Neighborhood poverty and racial differences in ESRD incidence. *J Am Soc Nephrol*. 2008;19(2):356-64.
10. Shoham DA, Vupputuri S, Roux AVD, Kaufman JS, Coresh J, Kshirsagar AV, et al. Kidney disease in life-course socioeconomic context: the Atherosclerosis Risk in Communities (ARIC) Study. *Am J Kidney Dis*. 2007;49(2):217-26.
11. Tarver-Carr ME, Powe NR, Eberhardt MS, LaVeist TA, Kington RS, Coresh J, et al. Excess risk of chronic kidney disease among African-American versus white subjects in the United States: a population-based study of potential explanatory factors. *J Am Soc Nephrol*. 2002;13(9):2363-70.
12. Adjei DN, Stronks K, Adu D, Beune E, Meeks K, Smeeth L, et al. Chronic kidney disease burden among African migrants in three European countries and in urban and rural Ghana: the RODAM cross-sectional study. *Nephrology Dialysis Transplantation*. 2018.
13. Adjei DN, Stronks K, Adu D, Snijder MB, Modesti PA, Peters RJ, et al. Relationship between educational and occupational levels, and Chronic Kidney Disease in a multi-ethnic sample-The HELIUS study. *PLoS One*. 2017;12(11):e0186460.
14. Fremont A, Bird CE. Social and psychological factors, physiological processes, and physical health. 2000.
15. Krantz DS, McCeney MK. Effects of psychological and social factors on organic disease: a critical assessment of research on coronary heart disease. *Annu Rev Psychol*. 2002;53(1):341-69.
16. Amerena J, Julius S. The role of the autonomic nervous system in hypertension. *Hypertens Res*. 1995;18(2):99-110.
17. Calhoun DA, Mutinga ML. Race, family history of hypertension, and sympathetic response to cold pressor testing. *Blood Press*. 1997;6(4):209-13.
18. Dibona GF. Neural control of the kidney: past, present, and future. *Hypertension*. 2003;41(3):621-4.
19. Auchincloss AH, Diez Roux AV, Brown DG, O'meara ES, Raghunathan TE. Association of insulin resistance with distance to wealthy areas: the multi-ethnic study of atherosclerosis. *Am J Epidemiol*. 2006;165(4):389-97.
20. Bruce MA, Sims M, Miller S, Elliott V, Ladipo M. One size fits all? Race, gender and body mass index among US adults. *J Natl Med Assoc*. 2007;99(10):1152.

21. Kim JW, Moon SJ, Kim HJ, Lee DG. Relationship between Chronic Kidney Disease and Depression in Elderly Koreans Using the 2013 Korea National Health and Nutrition Examination Survey Data. *Korean journal of family medicine*. 2017;38(3):156-62.
22. Loosman WL, Rottier MA, Honig A, Siegert CE. Association of depressive and anxiety symptoms with adverse events in Dutch chronic kidney disease patients: a prospective cohort study. *BMC Nephrol*. 2015;16(1):155.
23. Novak M, Mucsi I, Mendelssohn D. Screening for depression: only one piece of the puzzle. *Nephrology Dialysis Transplantation*. 2013;28(6):1336-40.
24. McKercher CM, Venn AJ, Blizzard L, Nelson MR, Palmer AJ, Ashby MA, et al. Psychosocial factors in adults with chronic kidney disease: characteristics of pilot participants in the Tasmanian Chronic Kidney Disease study. *BMC Nephrol*. 2013;14(1):83.
25. Cukor D, Fruchter Y, Ver Halen N, Naidoo S, Patel A, Saggi SJ. A preliminary investigation of depression and kidney functioning in patients with chronic kidney disease. *Nephron Clinical practice*. 2012;122(3-4):139-45.
26. Lunyera J, Davenport CA, Bhavsar NA, Sims M, Scialla J, Pendergast J, et al. Nondepressive Psychosocial Factors and CKD Outcomes in Black Americans. *Clin J Am Soc Nephrol*. 2018:CJN. 06430617.
27. Annor FB, Masyn KE, Okosun IS, Roblin DW, Goodman M. Psychosocial stress and changes in estimated glomerular filtration rate among adults with diabetes mellitus. *Kidney research and clinical practice*. 2015;34(3):146-53.
28. Gholson GK, Mwendwa DT, Wright RS, Callender CO, Campbell AL. The Combined Influence of Psychological Factors on Biomarkers of Renal Functioning in African Americans. *Ethn Dis*. 2015;25(2):117.
29. Kaur M, Kaur A, Saggi A, Kaur A, Kaur A, Arundee DK, et al. Comparative study on psychosocial stresses among urban and rural geriatric population in selected areas of district Ludhiana (Punjab), 2006. *Nursing and Midwifery Research*. 2007;3(2).
30. Agyemang C, Beune E, Meeks K, Owusu-Dabo E, Agyei-Baffour P, Aikins Ad-G, et al. Rationale and cross-sectional study design of the Research on Obesity and type 2 Diabetes among African Migrants: the RODAM study. *BMJ open*. 2015;4(3):e004877.
31. Agyemang C, Snijder MB, Adjei DN, van den Born B-JH, Modesti PA, Peters RJ, et al. Ethnic Disparities in CKD in the Netherlands: The Healthy Life in an Urban Setting (HELIUS) Study. *Am J Kidney Dis*. 2016;67(3):391-9.
32. Peek ME, Nunez-Smith M, Drum M, Lewis TT. Adapting the everyday discrimination scale to medical settings: reliability and validity testing in a sample of African American patients. *Ethn Dis*. 2011;21(4):502.
33. Pérez DJ, Fortuna L, Alegria M. Prevalence and correlates of everyday discrimination among US Latinos. *J Community Psychol*. 2008;36(4):421-33.
34. Ikram UZ, Snijder MB, Fassaert TJ, Schene AH, Kunst AE, Stronks K. The contribution of perceived ethnic discrimination to the prevalence of depression. *The European Journal of Public Health*. 2014;25(2):243-8.
35. Rosengren A, Hawken S, Ôunpuu S, Sliwa K, Zubaid M, Almahmeed WA, et al. Association of psychosocial risk factors with risk of acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the INTERHEART study): case-control study. *The Lancet*. 2004;364(9438):953-62.

- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
 - 13
 - 14
 - 15
 - 16
 - 17
 - 18
 - 19
 - 20
 - 21
 - 22
 - 23
 - 24
 - 25
 - 26
 - 27
 - 28
 - 29
 - 30
 - 31
 - 32
 - 33
 - 34
 - 35
 - 36
 - 37
 - 38
 - 39
 - 40
 - 41
 - 42
 - 43
 - 44
 - 45
 - 46
 - 47
 - 48
 - 49
 - 50
 - 51
 - 52
 - 53
 - 54
 - 55
 - 56
 - 57
 - 58
 - 59
 - 60
36. Rosmalen J, Bos E, De Jonge P. Validation of the Long-term Difficulties Inventory (LDI) and the List of Threatening Experiences (LTE) as measures of stress in epidemiological population-based cohort studies. *Psychol Med*. 2012;42(12):2599-608.
37. Brugha T, Bebbington P, Tennant C, Hurry J. The List of Threatening Experiences: a subset of 12 life event categories with considerable long-term contextual threat. *Psychol Med*. 1985;15(1):189-94.
38. Kroenke K, Spitzer RL, Williams JB. The phq-9. *J Gen Intern Med*. 2001;16(9):606-13.
39. Association AD. Standards of Medical Care in Diabetes—2014. *Diabetes Care* 2014; 37 (Suppl. 1): S14–S80. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 2014; 37 (Suppl. 1): S81–S90. *Diabetes Care*. 2014;37(3):887-.
40. Stevens LA, Schmid CH, Greene T, Zhang YL, Beck GJ, Froissart M, et al. Comparative performance of the CKD Epidemiology Collaboration (CKD-EPI) and the Modification of Diet in Renal Disease (MDRD) Study equations for estimating GFR levels above 60 mL/min/1.73 m². *Am J Kidney Dis*. 2010;56(3):486-95.
41. Kellum JA, Lameire N, Aspelin P, Barsoum RS, Burdmann EA, Goldstein SL, et al. Kidney disease: improving global outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury. *Kidney international supplements*. 2012;2(1):1-138.
42. KDIGO G. Work Group. KDIGO clinical practice guideline for glomerulonephritis. *Kidney inter, Suppl*. 2012;2:139-274.
43. Rivera B, Casal B, Currais L. Length of stay and mental health of the immigrant population in Spain: Evidence of the healthy immigrant effect. *Applied Economics*. 2015;47(19):1972-82.
44. Collins AJ, Foley RN, Herzog C, Chavers B, Gilbertson D, Ishani A, et al. US Renal Data System 2010 Annual Data Report. *American journal of kidney diseases: the official journal of the National Kidney Foundation*. 2011;57(1 Suppl 1):A8, e1.
45. Fox CS, Larson MG, Leip EP, Culleton B, Wilson PW, Levy D. Predictors of new-onset kidney disease in a community-based population. *JAMA*. 2004;291(7):844-50.
46. Banks J, Marmot M, Oldfield Z, Smith JP. Disease and disadvantage in the United States and in England. *JAMA*. 2006;295(17):2037-45.
47. Levin A, Stevens L, McCullough PA. Cardiovascular disease and the kidney: Tracking a killer in chronic kidney disease. *Postgrad Med*. 2002;111(4):53-60.
48. Tsai Y-C, Chiu Y-W, Hung C-C, Hwang S-J, Tsai J-C, Wang S-L, et al. Association of symptoms of depression with progression of CKD. *Am J Kidney Dis*. 2012;60(1):54-61.
49. Bruce MA, Griffith DM, Thorpe RJ. Stress and the kidney. *Adv Chronic Kidney Dis*. 2015;22(1):46-53.
50. Brummett BH, Barefoot JC, Siegler IC, Clapp-Channing NE, Lytle BL, Bosworth HB, et al. Characteristics of socially isolated patients with coronary artery disease who are at elevated risk for mortality. *Psychosom Med*. 2001;63(2):267-72.
51. Eng PM, Rimm EB, Fitzmaurice G, Kawachi I. Social ties and change in social ties in relation to subsequent total and cause-specific mortality and coronary heart disease incidence in men. *Am J Epidemiol*. 2002;155(8):700-9.
52. Patel SS, Peterson RA, Kimmel PL, editors. Psychosocial factors in patients with chronic kidney disease: The impact of social support on end-stage renal disease. *Seminars in dialysis*; 2005: Wiley Online Library.

- 1
2
3 53. Cohen SD, Sharma T, Acquaviva K, Peterson RA, Patel SS, Kimmel PL. Social support and
4 chronic kidney disease: an update. *Adv Chronic Kidney Dis.* 2007;14(4):335-44.
5
6 54. Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and
7 physiological processes: a review with emphasis on underlying mechanisms and implications for
8 health. *Psychol Bull.* 1996;119(3):488.
9
10 55. Tsurugano S, Nakao M, Takeuchi T, Nomura K, Yano E. Job stress strengthens the link
11 between metabolic risk factors and renal dysfunction in adult men. *The Tohoku journal of*
12 *experimental medicine.* 2012;226(2):101-8.
13
14 56. Tróccol BT. Desenvolvimento de escala para avaliação do suporte social em HIV/aids.
15 *Psicologia: Teoria e Pesquisa.* 2006;22(3):317-26.
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55

56 **Legend for figures**
57
58
59
60

1
2
3
4
5 **Figure 1:** Prevalence of CKD risk among Ghanaians who have experienced negative life events
6 and those who have not experienced any negative life events stratified by site. Definition per
7 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.
8
9

10 **Figure 2:** Prevalence of CKD risk among Ghanaians who have experienced discrimination and
11 those who have not experienced any discrimination stratified by site. Definitions per 2012
12 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.
13
14

15 **Figure 3:** Prevalence of CKD risk among Ghanaians who have experienced stress at
16 home/work and those who have not experienced any stress at home/work in the past 12
17 months stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global
18 Outcomes) guidelines.
19
20
21

22 **Figure 4:** Prevalence of CKD risk among Ghanaians who have depressive symptoms and those
23 who do not have depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney
24 Disease: Improving Global Outcomes) guidelines.
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

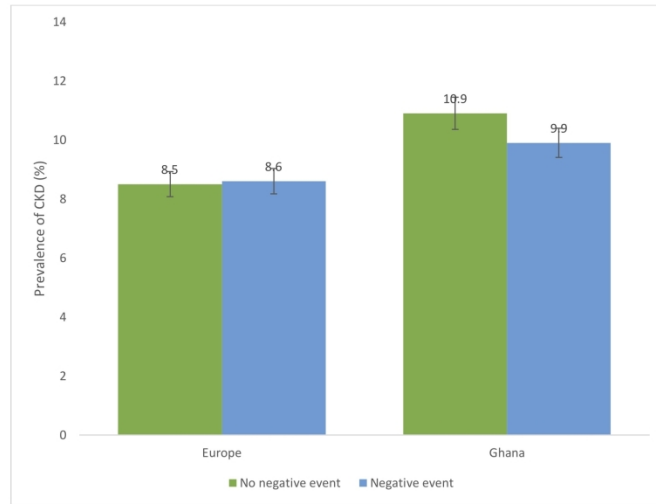


Figure 1: Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 1: Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

215x279mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

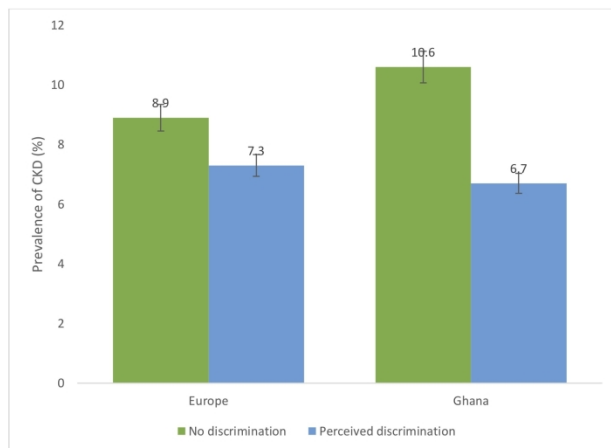


Figure 2: Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 2: Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

215x279mm (300 x 300 DPI)

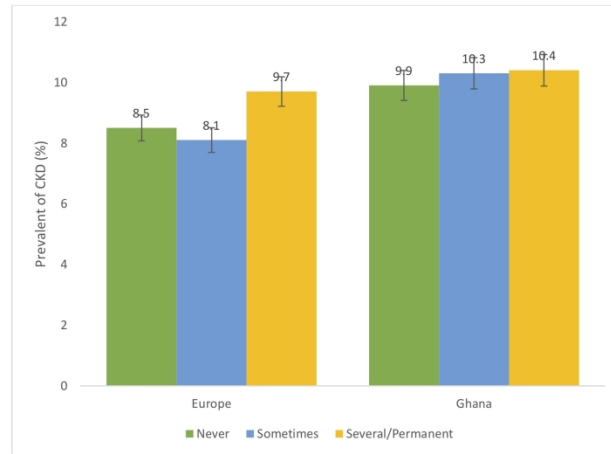


Figure 3: Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 3: Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

215x279mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

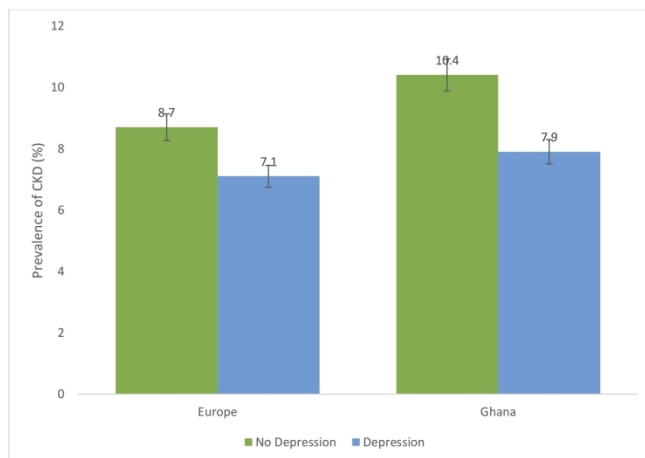


Figure 4: Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 4: Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines

215x279mm (300 x 300 DPI)

Supplementary Tables

S1: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe

	Albuminuria (ACR \geq 3 mg/mmol)		eGFR < 60 mL/min/1.73 m ²		High to very high CKD risk (KDIGO, 2012)	
	n (%)	OR (95% CI) Model 3	n (%)	OR (95% CI) Model 3	n cases (%)	OR (95% CI) Model 3
Negative events						
Europe						
No	1128 (8.2)	1.00 (Reference)	1106 (2.6)	1.00 (Reference)	1090 (8.5)	1.00 (Reference)
Yes	1615 (8.4)	0.95 (0.70-1.30)	1587 (2.5)	0.77 (0.44-1.37)	1557 (8.6)	0.92 (0.67-1.26)
Ghana						
No	732 (10.4)	1.00 (Reference)	736 (4.5)	1.00 (Reference)	732 (10.9)	1.00 (Reference)
Yes	1595 (9.2)	0.79 (0.58-1.07)	1601 (3.4)	0.69 (0.43-1.09)	1590 (9.9)	0.79 (0.58-1.06)
Discrimination						
Europe						
No	1899 (8.5)	1.00 (Reference)	1867 (2.6)	1.00 (Reference)	1832 (8.9)	1.00 (Reference)
Yes	810 (7.4)	0.87 (0.61-1.21)	791 (2.2)	0.87 (0.45-1.65)	782 (7.3)	0.79 (0.55-1.12)
Ghana						
No	2034 (10.0)	1.00 (Reference)	2047 (3.9)	1.00 (Reference)	2031 (10.6)	1.00 (Reference)
Yes	104 (7.7)	0.92 (0.43-1.98)	104 (1.9)	0.65 (0.15-2.79)	104 (6.7)	0.74 (0.33-1.66)
Stress at home/work						
Europe						
Never	1330 (8.2)	1.00 (Reference)	1305 (3.4)	1.00 (Reference)	1282 (8.5)	1.00 (Reference)
Some stress	1002 (7.9)	1.01 (0.72-1.41)	984 (1.4)	0.51 (0.25-1.04)	968 (8.1)	1.01 (0.72-1.42)
Several/Permanent stresses	397 (9.1)	1.00 (0.64-1.59)	390 (2.3)	0.91 (0.40-2.03)	383 (9.7)	1.15 (0.74-1.79)

Ghana

Never	682 (10.3)	1.00 (Reference)	688 (3.3)	1.00 (Reference)	682 (9.9)	1.00 (Reference)
Some stress	1279 (9.5)	0.78 (0.56-1.09)	1279 (3.9)	1.14 (0.67-1.93)	1274 (10.3)	0.93 (0.67-1.29)
Several/Permanent stresses	365 (8.5)	0.70 (0.43-1.13)	369 (4.1)	1.32 (0.65-1.68)	365 (10.4)	0.97 (0.62-1.52)

Depressive symptoms**Europe**

No	2505 (8.5)	1.00 (Reference)	2457 (2.7)	1.00 (Reference)	2416 (8.7)	1.00 (Reference)
Yes	206 (6.3)	0.65 (0.33-1.28)	202 (1.5)	0.94 (0.28-3.14)	199 (7.1)	0.78 (0.41-1.47)

Ghana

No	2212 (9.9)	1.00 (Reference)	2222 (3.8)	1.00 (Reference)	2207 (10.4)	1.00 (Reference)
Yes	114 (5.3)	0.41 (0.16-1.04)	114 (2.6)	0.58 (0.17-1.95)	114 (7.9)	0.62 (0.28-1.31)

Model 3, adjusted for age, sex educational level, hypertension, diabetes, hypercholesterolemia, BMI, physical activity and smoking; Abbreviations: CI, confidence interval; ACR, albumin creatinine ratio; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

S2: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by obesity status

	Albuminuria (ACR ≥ 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)	Model 2	n (%)	OR (95% CI)	Model 2	n cases (%)	OR (95% CI)	Model 2
Negative events									
Europe/Not obese									
No	736 (7.4)	1.00 (Reference)	1.00 (Reference)	729 (2.5)	1.00 (Reference)	1.00 (Reference)	719 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	1003 (7.7)	0.98 (0.67-1.40)	0.99 (0.69-1.43)	992 (2.0)	0.77 (0.40-1.48)	0.71 (0.36-1.42)	971 (7.9)	0.91 (0.64-1.29)	0.89 (0.62-1.29)
Europe/Obese									
No	390 (9.2)	1.00 (Reference)	1.00 (Reference)	375 (2.9)	1.00 (Reference)	1.00 (Reference)	369 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	607 (9.6)	1.05 (0.67-1.63)	1.14 (0.72-1.82)	590 (3.2)	0.97 (0.44-2.11)	1.01 (0.44-2.26)	581 (9.6)	1.15 (0.73-1.82)	1.15 (0.71-1.85)
Ghana/Not obese									
No	588 (9.5)	1.00 (Reference)	1.00 (Reference)	592 (4.7)	1.00 (Reference)	1.00 (Reference)	588 (10.0)	1.00 (Reference)	1.00 (Reference)
Yes	1324 (8.5)	0.86 (0.61-1.21)	0.83 (0.59-1.17)	1331 (3.4)	0.64 (0.39-1.05)	0.65 (0.39-1.83)	1321 (9.0)	0.86 (0.61-1.20)	0.84 (0.60-1.18)
Ghana/Obese									
No	144 (13.9)	1.00 (Reference)	1.00 (Reference)	144 (3.5)	1.00 (Reference)	1.00 (Reference)	144 (14.6)	1.00 (Reference)	1.00 (Reference)
Yes	268 (13.1)	0.91 (0.50-1.64)	0.91 (0.49-1.65)	267 (3.8)	1.04 (0.34-3.16)	1.09 (0.35-3.37)	266 (14.3)	0.94 (0.52-1.68)	0.94 (0.52-1.67)
Discrimination									
Europe/Not obese									
No	1186 (8.4)	1.00 (Reference)	1.00 (Reference)	1172 (2.4)	1.00 (Reference)	1.00 (Reference)	1150 (9.4)	1.00 (Reference)	1.00 (Reference)
Yes	538 (5.9)	0.69 (0.46-1.05)	0.71 (0.46-1.11)	532 (1.5)	0.62 (0.28-1.37)	0.57 (0.24-1.34)	525 (5.9)	0.63 (0.42-0.96)	0.63 (0.41-0.97)
Europe/Obese									
No	709 (8.7)	1.00 (Reference)	1.00 (Reference)	691 (3.0)	1.00 (Reference)	1.00 (Reference)	678 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	269 (10.0)	1.14 (0.71-1.85)	1.29 (0.78-2.12)	256 (3.5)	1.15 (0.50-2.63)	1.27 (0.54-2.99)	254 (9.8)	1.13 (0.69-1.86)	1.22 (0.73-2.13)
Ghana/Not obese									
No	1648 (9.1)	1.00 (Reference)	1.00 (Reference)	1661 (3.9)	1.00 (Reference)	1.00 (Reference)	1646 (9.6)	1.00 (Reference)	1.00 (Reference)
Yes	81 (8.6)	1.06 (0.48-2.38)	1.04 (0.47-2.32)	81 (2.5)	1.04 (0.48-2.32)	0.86 (0.20-3.69)	81 (7.4)	0.90 (0.38-2.12)	0.89 (0.38-2.11)

1										
2										
3										
4	Ghana/Obese									
5	No	383 (13.8)	1.00 (Reference)	1.00 (Reference)	383 (3.7)	1.00 (Reference)	1.00 (Reference)	382 (14.9)	1.00 (Reference)	1.00 (Reference)
6	Yes	23 (4.4)	0.31 (0.04-2.36)	0.40 (0.05-3.11)	23 (0.0)	**** (***_***)	**** (***_***)	23 (4.4)	0.29 (0.04-2.22)	0.34 (0.04-2.66)
7										
8	Stress at home/work									
9										
10	Europe/Not obese									
11	Never	855 (7.4)	1.00 (Reference)	1.00 (Reference)	847 (3.4)	1.00 (Reference)	1.00 (Reference)	831 (8.2)	1.00 (Reference)	1.00 (Reference)
12	Some stress	629 (8.3)	1.16 (0.79-1.70)	1.20 (0.81-1.79)	627 (1.4)	0.52 (0.24-1.12)	0.47 (0.21-1.07)	615 (7.9)	0.98 (0.66-1.43)	0.98 (0.65-1.46)
13	Several/Permanent stresses	247 (6.9)	0.93 (0.53-1.62)	1.15 (0.77-1.72)	239 (2.3)	0.45 (0.13-1.52)	0.49 (0.15-1.67)	236 (9.1)	0.97 (0.57-1.65)	1.04 (0.61-1.78)
14										
15	Europe/Obese									
16	Never	472 (9.8)	1.00 (Reference)	1.00 (Reference)	455 (3.9)	1.00 (Reference)	1.00 (Reference)	448 (10.3)	1.00 (Reference)	1.00 (Reference)
17	Some stress	372 (7.5)	0.72 (0.44-1.18)	0.79 (0.47-1.32)	356 (1.4)	0.41 (0.15-1.16)	0.43 (0.15-1.21)	352 (9.5)	0.94 (0.57-1.53)	1.05 (0.62-1.76)
18	Several/Permanent stresses	147 (12.2)	1.32 (0.74-2.38)	1.31 (0.72-2.42)	148 (4.1)	1.05 (0.40-2.79)	1.09 (0.40-2.91)	144 (8.5)	1.36 (0.74-2.49)	1.41 (0.75-2.64)
19										
20										
21	Ghana/Not obese									
22	Never	537 (9.7)	1.00 (Reference)	1.00 (Reference)	542 (3.1)	1.00 (Reference)	1.00 (Reference)	537 (8.9)	1.00 (Reference)	1.00 (Reference)
23	Some stress	1055 (8.3)	0.79 (0.56-1.15)	0.74 (0.52-1.07)	1057 (3.9)	1.16 (0.65-2.09)	1.21 (0.67-2.18)	1052 (9.0)	0.92 (0.64-1.35)	0.90 (0.62-1.32)
24	Several/permanent stresses	319 (8.5)	0.81 (0.49-1.32)	0.73 (0.44-1.20)	323 (4.3)	1.34 (0.64-2.83)	1.43 (0.67-3.04)	319 (10.7)	1.12 (0.69-1.79)	1.09 (0.68-1.76)
25										
26										
27	Ghana/Obese									
28	Never	145 (12.4)	1.00 (Reference)	1.00 (Reference)	146 (4.1)	1.00 (Reference)	1.00 (Reference)	145 (13.8)	1.00 (Reference)	1.00 (Reference)
29	Some stress	221 (14.9)	1.21 (0.64-2.26)	1.05 (0.55-1.99)	219 (3.7)	0.74 (0.25-2.22)	0.83 (0.26-2.06)	219 (15.9)	1.13 (0.62-2.07)	1.02 (0.55-1.89)
30	Several/Permanent stresses	46 (8.7)	0.64 (0.20-2.01)	0.52 (0.16-1.65)	46 (2.2)	0.41 (0.05-3.61)	0.45 (0.05-4.01)	46 (8.8)	0.55 (0.17-1.71)	0.47 (0.14-1.50)
31										
32										
33	Depressive symptoms									
34										
35	Europe/Not obese									
36	No	1601 (7.9)	1.00 (Reference)	1.00 (Reference)	1586 (2.2)	1.00 (Reference)	1.00 (Reference)	1558 (8.3)	1.00 (Reference)	1.00 (Reference)
37	Yes	121 (4.9)	0.59 (0.25-1.36)	0.65 (0.27-1.48)	117 (1.7)	0.79 (0.18-2.35)	0.86 (0.21-3.80)	115 (5.22)	0.58 (0.25-1.35)	0.64 (0.27-1.49)
38										
39	Europe/Obese									
40	No	899 (9.7)	1.00 (Reference)	1.00 (Reference)	866 (3.4)	1.00 (Reference)	1.00 (Reference)	853 (9.4)	1.00 (Reference)	1.00 (Reference)
41										
42										
43										
44										
45										
46										
47										

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Yes	83 (7.2)	0.71 (0.29-1.67)	0.72 (0.30-1.74)	83 (1.2)	0.46 (0.06-3.52)	0.46 (0.06-3.57)	82 (8.5)	0.89 (0.40-2.01)	0.90 (0.40-2.04)
Ghana/Not obese									
No	1811 (8.9)	1.00 (Reference)	1.00 (Reference)	1822 (3.9)	1.00 (Reference)	1.00 (Reference)	1808 (9.4)	1.00 (Reference)	1.00 (Reference)
Yes	100 (6.0)	0.57 (0.24-1.33)	0.56 (0.24-1.32)	100 (2.0)	0.38 (0.09-1.63)	0.38 (0.09-1.63)	100 (8.0)	0.69 (0.32-1.46)	0.69 (0.32-1.47)
Ghana/Obese									
No	398 (13.8)	1.00 (Reference)	1.00 (Reference)	397 (3.5)	1.00 (Reference)	1.00 (Reference)	396 (14.7)	1.00 (Reference)	1.00 (Reference)
Yes	14 (0.0)	*** (****_****)	*** (****_****)	14 (7.1)	1.76 (0.21-14.89)	2.14 (0.25-8.78)	14 (7.1)	0.42 (0.05-3.32)	0.38 (0.05-3.07)

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

Peer review only

S3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by diabetes status

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)	Model 2	n (%)	OR (95% CI)	Model 2	n cases (%)	OR (95% CI)	Model 2
Negative events									
Europe/No diabetes									
No	986 (8.0)	1.00 (Reference)	1.00 (Reference)	971 (2.1)	1.00 (Reference)	1.00 (Reference)	957 (7.9)	1.00 (Reference)	1.00 (Reference)
Yes	1359 (7.7)	0.95 (0.70-1.29)	0.97 (0.71-1.34)	1340 (2.0)	0.90 (0.50-1.63)	0.90 (0.48-1.68)	1315 (8.1)	1.01 (0.75-1.37)	0.99 (0.72-1.36)
Europe/Diabetes									
No	142 (9.9)	1.00 (Reference)	1.00 (Reference)	135 (6.7)	1.00 (Reference)	1.00 (Reference)	133 (12.8)	1.00 (Reference)	1.00 (Reference)
Yes	256 (12.5)	1.28 (0.66-2.50)	1.41 (0.71-2.82)	247 (4.9)	0.75 (0.29-1.89)	10.68 (0.27-1.77)	242 (11.2)	0.87 (0.46-1.69)	0.96 (0.49-1.88)
Ghana/No diabetes									
No	683 (9.1)	1.00 (Reference)	1.00 (Reference)	687 (4.1)	1.00 (Reference)	1.00 (Reference)	683 (9.8)	1.00 (Reference)	1.00 (Reference)
Yes	1447 (7.7)	0.84 (0.60-1.16)	0.82 (0.59-1.14)	1451 (3.1)	0.69 (0.42-1.13)	0.69 (0.42-1.13)	1442 (8.3)	0.82 (0.59-1.12)	0.80 (0.58-1.10)
Ghana/Diabetes									
No	49 (28.3)	1.00 (Reference)	1.00 (Reference)	49 (10.2)	1.00 (Reference)	1.00 (Reference)	49 (26.4)	1.00 (Reference)	1.00 (Reference)
Yes	148 (24.3)	0.78 (0.37-1.61)	0.72 (0.34-1.52)	150 (7.3)	0.55 (0.16-1.81)	0.57 (0.17-1.88)	148 (26.4)	0.93 (0.45-1.97)	0.90 (0.43-1.92)
Discrimination									
Europe/No diabetes									
No	1629 (7.9)	1.00 (Reference)	1.00 (Reference)	1609 (2.2)	1.00 (Reference)	1.00 (Reference)	1580 (8.3)	1.00 (Reference)	1.00 (Reference)
Yes	684 (6.7)	0.85 (0.60-1.21)	0.89 (0.62-1.28)	669 (1.5)	0.68 (0.33-1.40)	0.69 (0.32-1.47)	661 (7.0)	0.84 (0.59-1.20)	0.86 (0.59-1.25)
Europe/Diabetes									

1										
2										
3	No	270 (11.9)	1.00 (Reference)	1.00 (Reference)	258 (5.4)	1.00 (Reference)	1.00 (Reference)	252 (13.1)	1.00 (Reference)	1.00 (Reference)
4	Yes	126 (11.1)	0.87 (0.44-1.71)	0.89 (0.45-1.76)	122 (5.7)	1.29 (0.48-3.45)	1.25 (0.46-3.37)	121 (9.1)	0.68 (0.32-1.40)	0.69 (0.33-1.42)
5	Ghana/No diabetes									
6										
7	No	1854 (8.4)	1.00 (Reference)	1.00 (Reference)	1865 (3.5)	1.00 (Reference)	1.00 (Reference)	1851 (9.0)	1.00 (Reference)	1.00 (Reference)
8	Yes	99 (8.1)	1.03 (0.49-2.17)	1.04 (0.49-2.19)	99 (2.0)	0.79 (0.19-3.33)	0.78 (0.18-3.29)	99 (7.1)	0.87 (0.39-1.93)	0.88 (0.39-1.95)
9	Ghana/Diabetes									
10										
11	No	180 (26.7)	1.00 (Reference)	1.00 (Reference)	182 (7.7)	1.00 (Reference)	1.00 (Reference)	180 (27.2)	1.00 (Reference)	1.00 (Reference)
12	Yes	5 (0.0)	**** (***_***)	0.40 (0.05-3.11)	5 (0.0)	**** (***_***)	**** (***_***)	5 (0.0)	**** (***_***)	**** (***_***)
13	Stress at home/work									
14										
15	Europe/No diabetes									
16										
17	Never	1137 (7.9)	1.00 (Reference)	1.00 (Reference)	1127 (2.3)	1.00 (Reference)	1.00 (Reference)	1102 (8.0)	1.00 (Reference)	1.00 (Reference)
18	Some stress	860 (7.2)	0.90 (0.65-1.27)	0.96 (0.68-1.36)	850 (1.2)	0.49 (0.24-1.02)	0.49 (0.22-1.07)	835 (7.4)	0.94 (0.67-1.31)	0.99 (0.69-1.41)
19	Several/Permanent stresses	335 (8.4)	1.04 (0.67-1.62)	1.07 (0.68-1.70)	327 (2.1)	0.84 (0.36-1.95)	0.92 (0.39-2.17)	322 (9.6)	1.20 (0.77-1.85)	1.28 (0.82-1.99)
20	Europe/Diabetes									
21										
22	Never	193 (9.8)	1.00 (Reference)	1.00 (Reference)	184 (8.2)	1.00 (Reference)	1.00 (Reference)	180 (11.7)	1.00 (Reference)	1.00 (Reference)
23	Some stress	142 (12.7)	1.22 (0.61-2.45)	1.38 (0.67-2.81)	134 (3.0)	0.43 (0.13-1.39)	0.40 (0.12-1.29)	133 (12.0)	1.04 (0.52-2.09)	1.13 (0.56-2.32)
24	Several/Permanent stresses	62 (12.9)	1.31 (0.54-3.16)	1.38 (0.56-3.41)	63 (3.2)	0.49 (0.10-2.29)	0.46 (0.10-2.23)	61 (9.8)	0.82 (0.31-2.13)	0.89 (0.34-2.35)
25	Ghana/No diabetes									
26										
27	Never	628 (7.8)	1.00 (Reference)	1.00 (Reference)	634 (2.7)	1.00 (Reference)	1.00 (Reference)	628 (7.6)	1.00 (Reference)	1.00 (Reference)
28	Some stress	1163 (8.6)	1.06 (0.74-1.51)	0.97 (0.67-1.39)	1163 (3.7)	1.27 (0.71-2.27)	1.32 (0.74-2.34)	1158 (9.3)	1.15 (0.80-1.65)	1.10 (0.77-1.58)
29	Several/permanent stresses	339 (7.4)	0.88 (0.53-1.46)	0.76 (0.46-1.27)	341 (3.5)	1.24 (0.58-2.67)	1.35 (0.62-2.95)	339 (8.9)	1.07 (0.66-1.73)	1.00 (0.61-1.64)
30	Ghana/Diabetes									
31										
32	Never	54 (38.9)	1.00 (Reference)	1.00 (Reference)	54 (11.1)	1.00 (Reference)	1.00 (Reference)	54 (37.0)	1.00 (Reference)	1.00 (Reference)
33	Some stress	116 (18.9)	0.37 (0.37-0.77)	0.35 (0.17-0.75)	116 (6.0)	0.47 (0.14-1.60)	0.45 (0.12-1.55)	116 (19.8)	0.43 (0.21-0.89)	0.40 (0.19-0.86)
34	Several/Permanent stresses	26 (25.0)	0.44 (0.44-1.29)	0.39 (0.13-1.19)	28 (10.7)	0.65 (0.13-3.21)	0.62 (0.12-3.23)	26 (30.8)	0.69 (0.25-1.93)	0.64 (0.22-1.87)
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										

Depressive symptoms										
Europe/No diabetes										
No	2154 (8.0)	1.00 (Reference)	1.00 (Reference)	2122 (2.1)	1.00 (Reference)	1.00 (Reference)	2087 (8.1)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	167 (5.4)	0.63 (0.32-1.25)	0.69 (0.34-1.38)	163 (2.0)	0.65 (0.15-2.72)	0.72 (0.17-3.04)	161 (6.8)	0.58 (0.25-1.35)	0.86 (0.46-1.64)	0.86 (0.46-1.64)
Europe/Diabetes										
No	351 (12.0)	1.00 (Reference)	1.00 (Reference)	335 (35.9)	1.00 (Reference)	1.00 (Reference)	329 (12.5)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	39 (10.3)	0.79 (0.26-1.35)	0.73 (0.24-2.19)	39 (2.6)	0.49 (0.06-3.97)	0.49 (0.06-3.99)	38 (7.9)	0.89 (0.40-2.01)	0.60 (0.17-2.08)	0.60 (0.17-2.08)
Ghana/No diabetes										
No	2027 (8.3)	1.00 (Reference)	1.00 (Reference)	2035 (3.4)	1.00 (Reference)	1.00 (Reference)	2022 (8.8)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	102 (4.9)	0.50 (0.20-1.25)	0.48 (0.19-1.19)	102 (2.9)	0.64 (0.19-2.13)	0.67 (0.20-2.21)	102 (7.8)	0.69 (0.32-1.46)	0.71 (0.34-1.51)	0.71 (0.34-1.51)
Ghana/Diabetes										
No	185 (26.5)	1.00 (Reference)	1.00 (Reference)	187 (8.7)	1.00 (Reference)	1.00 (Reference)	185 (27.6)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	12 (8.3)	0.27 (0.03-2.13)	0.25 (0.03-2.01)	12 (0.0)	*** (****_****)	*** (***_***)	12 (8.3)	0.42 (0.05-3.32)	0.27 (0.03-2.19)	0.27 (0.03-2.19)

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

S4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by hypertensive status

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe/No hypertension									
No	568 (6.9)	1.00 (Reference)	1.00 (Reference)	562 (1.3)	1.00 (Reference)	1.00 (Reference)	551 (7.1)	1.00 (Reference)	1.00 (Reference)
Yes	743 (5.0)	0.72 (0.45-1.15)	0.78 (0.48-1.27)	740 (0.8)	0.59 (0.19-1.77)	0.60 (0.20-1.83)	724 (5.1)	0.71 (0.44-1.13)	0.75 (0.46-1.22)
Europe/Hypertension									
No	560 (9.6)	1.00 (Reference)	1.00 (Reference)	544 (4.0)	1.00 (Reference)	1.00 (Reference)	539 (10.0)	1.00 (Reference)	1.00 (Reference)
Yes	872 (11.4)	1.22 (0.86-1.73)	1.20 (0.83-1.73)	847 (3.9)	0.95 (0.54-1.67)	0.89 (0.49-1.62)	833 (11.6)	1.19 (0.83-1.69)	1.13 (0.78-1.62)
Ghana/No Hypertension									
No	540 (6.3)	1.00 (Reference)	1.00 (Reference)	543 (2.2)	1.00 (Reference)	1.00 (Reference)	540 (6.9)	1.00 (Reference)	1.00 (Reference)
Yes	1118 (5.6)	0.88 (0.57-1.36)	0.84 (0.54-1.31)	1124 (1.9)	0.82 (0.39-1.69)	0.86 (0.41-1.79)	1115 (6.4)	0.93 (0.61-1.40)	0.90 (0.59-1.36)
Ghana/Hypertension									
No	192 (21.9)	1.00 (Reference)	1.00 (Reference)	193 (10.9)	1.00 (Reference)	1.00 (Reference)	192 (22.4)	1.00 (Reference)	1.00 (Reference)
Yes	476 (18.1)	0.78 (0.52-1.18)	0.79 (0.52-1.20)	476 (6.9)	0.58 (0.32-1.04)	0.58 (0.33-1.05)	474 (18.4)	0.77 (0.50-1.16)	0.76 (0.51-1.16)

Discrimination									
Europe/No hypertension									
No	916 (6.3)	1.00 (Reference)	1.00 (Reference)	907 (0.8)	1.00 (Reference)	1.00 (Reference)	885 (6.8)	1.00 (Reference)	1.00 (Reference)
Yes	379 (3.7)	0.60 (0.33-1.09)	0.65 (0.36-1.21)	378 (1.1)	1.35 (0.39-4.74)	1.37 (0.38-4.89)	374 (3.2)	0.47 (0.25-0.89)	0.51 (0.27-0.97)
Europe/Hypertension									
No	983 (10.5)	1.00 (Reference)	1.00 (Reference)	960 (4.4)	1.00 (Reference)	1.00 (Reference)	947 (10.9)	1.00 (Reference)	1.00 (Reference)
Yes	431 (10.7)	1.03 (0.71-1.49)	1.05 (0.72-1.54)	413 (3.2)	0.73 (0.38-1.39)	0.75 (0.38-1.48)	408 (11.0)	1.03 (0.71-1.49)	1.04 (0.71-1.53)
Ghana/No hypertension									
No	1427 (5.7)	1.00 (Reference)	1.00 (Reference)	1437 (2.2)	1.00 (Reference)	1.00 (Reference)	1424 (6.5)	1.00 (Reference)	1.00 (Reference)
Yes	81 (7.4)	1.30 (0.55-3.09)	1.30 (0.55-3.10)	81 (0.0)	**** (***)	**** (***)	81 (7.4)	1.21 (0.51-2.88)	1.22 (0.51-2.89)
Ghana/Hypertension									
No	606 (20.3)	1.00 (Reference)	1.00 (Reference)	609 (7.9)	1.00 (Reference)	1.00 (Reference)	606 (20.3)	1.00 (Reference)	1.00 (Reference)
Yes	23 (8.7)	0.38 (0.09-1.68)	0.40 (0.09-1.74)	23 (8.7)	1.27 (0.28-5.70)	1.20 (0.26-5.44)	23 (4.4)	0.19 (0.03-1.44)	0.19 (0.03-1.45)
Stress at home/work									
Europe/No hypertension									
Never	644 (6.1)	1.00 (Reference)	1.00 (Reference)	640 (1.3)	1.00 (Reference)	1.00 (Reference)	625 (5.8)	1.00 (Reference)	1.00 (Reference)
Some stress	468 (4.5)	0.74 (0.43-1.27)	0.81 (0.46-1.43)	464 (0.4)	0.37 (0.07-1.74)	0.41 (0.09-2.01)	457 (4.8)	0.84 (0.49-1.45)	0.91 (0.52-1.60)
Several/Permanent stresses	192 (6.8)	1.07 (0.56-2.05)	1.19 (0.61-2.29)	191 (1.6)	1.49 (0.38-5.78)	1.52 (0.39-5.98)	186 (8.1)	1.38 (0.74-2.60)	1.49 (0.79-2.84)
Europe/Hypertension									
Never	686 (10.2)	1.00 (Reference)	1.00 (Reference)	665 (5.4)	1.00 (Reference)	1.00 (Reference)	657 (11.1)	1.00 (Reference)	1.00 (Reference)
Some stress	534 (11.1)	1.03 (0.71-1.49)	1.05 (0.72-1.54)	520 (2.3)	0.49 (0.25-0.96)	0.47 (0.23-0.95)	511 (10.9)	0.97 (0.67-1.41)	0.99 (0.67-0.47)
Several/Permanent stresses	205 (11.2)	1.11 (0.67-1.82)	1.12 (0.67-1.87)	199 (3.0)	0.56 (0.23-1.37)	0.58 (0.24-1.43)	197 (11.2)	0.99 (0.59-1.64)	1.03 (0.61-1.74)
Ghana/No hypertension									
Never	495 (5.5)	1.00 (Reference)	1.00 (Reference)	498 (1.4)	1.00 (Reference)	1.00 (Reference)	495 (5.9)	1.00 (Reference)	1.00 (Reference)
Some stress	899 (5.9)	1.07 (0.66-1.73)	0.99 (0.61-1.60)	901 (2.2)	1.30 (0.54-3.15)	1.39 (0.57-3.37)	896 (6.5)	1.04 (0.65-1.65)	1.00 (0.63-1.59)

1										
2										
3	Several/permanent stresses	263 (5.7)	1.01 (0.53-1.95)	0.89 (0.46-1.72)	267 (2.6)	1.69 (0.58-5.01)	1.89 (0.63-5.65)	263 (7.6)	1.21 (0.67-2.20)	1.15 (0.63-2.11)
4										
5	Ghana/Hypertension									
6										
7	Never	187 (22.9)	1.00 (Reference)	1.00 (Reference)	190 (8.4)	1.00 (Reference)	1.00 (Reference)	187 (20.9)	1.00 (Reference)	1.00 (Reference)
8	Some stress	379 (18.2)	0.74 (0.48-1.14)	0.68 (0.43-1.05)	377 (7.9)	0.95 (0.50-1.80)	0.99 (0.51-1.91)	377 (19.4)	0.90 (0.58-1.40)	0.87 (0.55-1.36)
9	Several/Permanent stresses	102 (15.7)	0.62 (0.33-1.17)	0.54 (0.28-1.04)	102 (7.8)	0.92 (0.37-2.26)	0.97 (0.39-2.43)	102 (17.7)	0.79 (0.42-1.49)	0.76 (0.40-1.43)
10										
11	Depressive symptoms									
12										
13	Europe/No hypertension									
14										
15	No	1195 (5.9)	1.00 (Reference)	1.00 (Reference)	1187 (1.1)	1.00 (Reference)	1.00 (Reference)	1162 (6.0)	1.00 (Reference)	1.00 (Reference)
16	Yes	101 (3.9)	0.59 (0.21-1.65)	0.64 (0.23-1.82)	99 (1.0)	1.18 (0.15-2.72)	1.27 (0.16-10.17)	98 (5.1)	0.77 (0.30-1.97)	0.84 (0.33-2.17)
17										
18	Europe/Hypertension									
19										
20	No	1310(10.9)	1.00 (Reference)	1.00 (Reference)	1270 (4.1)	1.00 (Reference)	1.00 (Reference)	1254 (11.2)	1.00 (Reference)	1.00 (Reference)
21	Yes	105 (8.6)	0.76 (0.37-1.53)	0.75 (0.37-1.55)	103 (1.9)	0.52 (0.12-2.18)	0.56 (0.13-2.38)	101 (8.9)	0.77 (0.38-1.58)	0.80 (0.39-1.63)
22										
23	Ghana/No hypertension									
24										
25	No	1575 (5.9)	1.00 (Reference)	1.00 (Reference)	1584 (2.1)	1.00 (Reference)	1.00 (Reference)	1572 (6.7)	1.00 (Reference)	1.00 (Reference)
26	Yes	82 (2.4)	0.36 (0.09-1.51)	0.35 (0.08-1.44)	82 (1.2)	0.39 (0.059-2.95)	0.39 (0.05-2.97)	82 (3.7)	0.44 (0.13-1.42)	0.43 (0.13-1.40)
27										
28	Ghana/Hypertension									
29										
30	No	636 (19.5)	1.00 (Reference)	1.00 (Reference)	637 (8.2)	1.00 (Reference)	1.00 (Reference)	634 (19.6)	1.00 (Reference)	1.00 (Reference)
31	Yes	32 (12.5)	0.59 (0.20-1.72)	0.59 (0.20-1.74)	32 (6.3)	0.74 (0.17-3.25)	0.76 (0.17-3.33)	32 (18.8)	0.94 (0.037-2.37)	0.94 (0.38-2.37)
32										
33										

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

For peer review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1,2	We have included a commonly used term in the title and abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2	Our study shows no convincing evidence for associations between stress as indicated by four PS constructs and prevalence of CKD. Further studies aimed at identifying potential factors driving the high prevalence of CKD among these populations are needed.
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	The theoretical and scientific background as well as the rationale for conducting the study have been provided in the introduction section.
Objectives	3	State specific objectives, including any prespecified hypotheses	4	We examined the

For peer review only

association between PS and CKD prevalence among rural and urban Ghanaians and their migrants living in three European cities. We also assessed if the influence of PS on CKD is partially mediated by primary risk factors (hypertension and diabetes) of CKD.

Methods

Study design	4	Present key elements of study design early in the paper	5-6	Details given in the methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6	Rural or urban Ghana and three (Amsterdam, Berlin, London) European cities (migrants)
Participants	6	<p>(a) <i>Cohort study</i>—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i>—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i>—Give the eligibility criteria, and the sources and methods of selection of participants</p>	6-8	A multi-centred cross sectional baseline data from the Research on Obesity and Diabetes among African Migrants (RODAM) study. A random sample of

5,659 adults (Europe, 3167, rural, 1,043, Urban Ghana, 1,449, Ghana) aged 25 to 70 years.

(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed
Case-control study—For matched studies, give matching criteria and the number of controls per case

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8	The main outcomes have been clearly defined.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8	We defined each variable of interest in the methods accordingly
Bias	9	Describe any efforts to address potential sources of bias	18	Potential sources of bias have discussed in the discussion section
Study size	10	Explain how the study size was arrived at	5	Given in the methods section and we have also referred to the RODAM study methods paper

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9	Please see methods
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9	Please see methods
		(b) Describe any methods used to examine subgroups and interactions	8-9	Please see methods
		(c) Explain how missing data were addressed	8-9	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	NA	We have reported non-response across sites
		(e) Describe any sensitivity analyses	NA	
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5	Non-response analysis was done to shed light on the differential response rates across sites
		(b) Give reasons for non-participation at each stage	5	
		(c) Consider use of a flow diagram	5	We have also referred to RODAM methods paper
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5	We have also referred to RODAM methods paper
		(b) Indicate number of participants with missing data for each variable of interest	5	We have also referred to RODAM methods paper
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	NA	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	NA	
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	NA	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	9-10	Summary measures are given in the results section and in tables and figures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-16	Unadjusted and adjusted estimates are given in the results section and in figures
		(b) Report category boundaries when continuous variables were categorized	12-16	We have provided mean and corresponding standard deviations for the continuous variables.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time NA

Continued on next page

Other analyses 17 Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NA

Discussion

Key results 18 Summarise key results with reference to study objectives 8

Limitations 19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias 18 Key limitations regarding study methods including differential response rates and sampling methods in the various study sites have been provided

Interpretation 20 Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence 17-18 Cautious overall interpretation of the key findings have been provided.

Generalisability 21 Discuss the generalisability (external validity) of the study results 17-18

Other information

Funding 22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based 19 The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN PSYCHOSOCIAL STRESSORS WITH CHRONIC KIDNEY DISEASE AMONG MIGRANT AND NON-MIGRANT GHANAIS LIVING IN EUROPE AND GHANA: THE RODAM STUDY

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-027931.R1
Article Type:	Research
Date Submitted by the Author:	12-Mar-2019
Complete List of Authors:	<p>Adjei Nana, David ; University of Ghana, Department of Medical Laboratory Sciences; University of Amsterdam, Department of Public Health</p> <p>Stronks, Karien; Academic Medical Center , Department of Public Health Adu, Dwomoa; Korle-bu Teaching Hospital, Department of Medicine</p> <p>Beune, Erik; AMC</p> <p>Meeks, Karlijn; AMC, Public Health</p> <p>Smeeth, Liam; London School of Hygiene and Tropical Medicine, Addo, Juliet; London School of Hygiene and Tropical Medicine, Non Communicable Disease Epidemiology</p> <p>Owusu-Dabo, Ellis; Kwame Nkrumah University of Science and Technology, Kumasi Centre for Collaborative Research in Tropical Medicine</p> <p>Klipstein-Grobusch, Kerstin; 1 Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Centre Utrecht, Utrecht, The Netherlands</p> <p>Mockenhaupt, Frank; Charité – University Medicine, Berlin, Institute of Tropical Medicine and International Health</p> <p>Schulze, Matthias; German Institute of Human Nutrition Potsdam-Rehbruecke</p> <p>Danquah, Ina; German Institute of Human Nutrition, Molecular Epidemiology; Charite Universitatsmedizin Berlin, Institute for Social Medicine, Epidemiology and Health Economy</p> <p>Spranger, Joachim; Department of Endocrinology and Metabolism, 1. Charité-University Medicine Berlin, Berlin, Germany.</p> <p>Bahendeka, Silver; St. Francis Hospital Nsambya,</p> <p>Agyemang, Charles; Academic Medical centre, University of Amsterdam, Department of Public Health</p>
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Public health, Renal medicine
Keywords:	Chronic Kidney Disease, Psychosocial stressors, migrants, rodam study, Europe, Ghana

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



SCHOLARONE™
Manuscripts

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN PSYCHOSOCIAL
2 STRESSORS WITH CHRONIC KIDNEY DISEASE AMONG MIGRANT AND NON-
3 MIGRANT GHANAIS LIVING IN EUROPE AND GHANA: THE RODAM STUDY

4 David N. Adjei, MSc, PhD^{1,2}; Karien Stronks, MSc, PhD¹; Dwomoa Adu, MD³; Erik Beune, MSc, PhD¹;
5 Karlijn Meeks, MSc, PhD¹; Liam Smeeth, MD, PhD⁴; Juliet, Addo, MD, PhD⁴; Ellis Owusu-Dabo, MSc,
6 PhD⁵; Kerstin Klipstein-Grobusch, MSc, PhD^{6,7}; Frank P. Mockenhaupt, MD, PhD⁸; Matthias B. Schulze,
7 MSc, PhD⁹; Ina, Danquah, MSc, PhD^{9,10}; Joachim, Spranger, MD, PhD^{11,12,13}; Silver Bahendeka, MD,
8 PhD¹⁴; Charles Agyemang, MPH, PHD¹

- 9 1. Department of Public Health, Academic Medical Center, University of Amsterdam, Amsterdam,
10 Amsterdam Public Health Research Institute, Amsterdam, The Netherlands.
- 11 2. Department of Medical Laboratory Sciences, School of Biomedical and Allied Health Sciences,
12 College of Health Sciences, University of Ghana, Accra, Ghana.
- 13 3. Department of Medicine, School of Medicine and Dentistry, University of Ghana and Korle-Bu
14 Teaching Hospital, Accra, Ghana.
- 15 4. Department of Non-Communicable Disease Epidemiology, London School of Hygiene and Tropical
16 Medicine, London, United Kingdom.
- 17 5. Kumasi Centre for collaborative Research, KNUST, Kumasi, Ghana.
- 18 6. Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Centre,
19 Utrecht University, The Netherlands
- 20 7. Division of Epidemiology & Biostatistics, School of Public Health, Faculty of Health Sciences,
21 University of the Witwatersrand, Johannesburg, South Africa
- 22 8. Institute of Tropical Medicine and International Health, Charité –University Medicine Berlin,
23 Augustenburger Platz 1, 13353 Berlin, Germany.
- 24 9. Department of Molecular Epidemiology, German Institute of Human Nutrition Potsdam-Rehbrücke,
25 Nuthetal, Germany.
- 26 10. Charité - Universitaetsmedizin Berlin, Institute for Social Medicine, Epidemiology and Health
27 Economics, Berlin, Germany.
- 28 11. Department of Endocrinology and Metabolism, Charité-University Medicine Berlin, Berlin, Germany.
- 29 12. German Centre for Cardiovascular Research (DZHK), Berlin, Germany.
- 30 13. Center for Cardiovascular Research (CCR), Charité-University, Medicine, Berlin, Germany.
- 31
- 32 14. MKPGMS - Uganda Martyrs University, Kampala, Uganda.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

39 Address correspondence to David Nana Adjei, MSc, Department of Public Health, Academic Medical
40 Centre, University of Amsterdam, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands, School
41 Biomedical and Allied Health Sciences, Medical Laboratory Sciences, University of Ghana, E-mail:
42 dna@chs.edu.gh, d.n.adjei@amc.uva.nl, Tel: +233236717850

For peer review only

Abstract

Objectives: The association between Psychosocial stressors (PS) and CKD among sub-Saharan African (SSA) populations is unknown. We examined the association between PS and CKD prevalence among rural and urban Ghanaians and Ghanaian migrants living in three European cities. We also assessed if the influence of PS on CKD is partially mediated by primary risk factors (hypertension and diabetes) of CKD.

Design: A multi-centred cross sectional data from the Research on Obesity and Diabetes among African Migrants (RODAM) study.

Setting: Rural and urban Ghana and three European cities (Amsterdam, Berlin and London).

Participants: A random sample of 5,659 adults (Europe 3167, rural Ghana 1,043, and Urban Ghana 1,449) aged 25 to 70 years.

Explanatory and outcome measures: PS was defined by negative life events, perceived discrimination, perceived stress at work/home and depressive symptoms. Three CKD outcomes were considered using the 2012 KDIGO (Kidney Disease: Improving Global Outcomes) severity of CKD classification. Comparisons between PS and CKD outcomes were made using logistic regression analyses across all sites.

Results: We observed higher proportion of negative life events (68.7%) and perceived permanent stress (15.9%) among Ghanaians living in Ghana than Ghanaians living in Europe. Depressive symptoms (7.5%) and perceived discrimination (29.7%) were more common among Ghanaians living in Europe than Ghanaians living in Ghana. No significant association was observed between any of the PS constructs and CKD outcomes across sites except for positive association between stress at work/home and albuminuria (2.81, 95% C.I. 1.46-5.40) and CKD risk (2.78, 95% C.I. 1.43-5.43) among Ghanaians living in Berlin.

Conclusion: Our study shows no convincing evidence of associations between PS constructs and the prevalence of CKD outcomes. Further studies are needed to identify potential factors driving the high prevalence of CKD among these populations.

Index Words: Chronic kidney disease; psychosocial stressors; risk factor; migrants; RODAM study, Europe, Ghana

Strengths and limitations of the study

- This study used all three categories of CKD definitions (albuminuria, reduced eGFR and CKD risk) by KDIGO 2012 in assessing association of SS with CKD across all sites. This provided more detailed information on CKD outcomes.
- All sites in our study used well standardized study protocols and this eliminated intra protocol variability.
- The use of four constructs of psychosocial stressors (negative life events, perceived discrimination, perceived stress at work/home and depressive symptoms) provided a robust approach to assessing SS associations with CKD.
- The limitation of intra laboratory variability in earlier studies was eliminated using the same standard operating procedures in the same laboratory for running all samples for all sites.
- PS is captured and experienced in different magnitude across different populations. We were unable to ascertain if PS as defined in this study was adequately captured among Ghanaians living in rural and urban Ghana.

180 Introduction

181
182 Worldwide, Chronic Kidney Disease (CKD) is a leading cause of mortality and morbidity with several risk
183 factors (diabetes mellitus, obesity, hypertension and cardiovascular disease)¹. The epidemiologic transition
184 in low-and-middle income countries (LMICs) shows increased burden of these risk factors²⁻⁴. CKD's high
185 morbidity and mortality is mostly driven by uncontrolled comorbidities such as diabetes and hypertension
186^{5 6}. CKD treatment and management cost is very high and not sustainable even in high-income countries
187 and this underscores the need for prevention⁷. Available literature has shown that both individual and
188 community level economic factors influence CKD⁸⁻¹⁰. However, after adjusting for both individual and
189 community level socioeconomic position, differences in CKD risk among different populations remained⁸
190^{10 11}. These findings seem to suggest that other social environmental factors may be driving CKD prevalence
191 and progression in high-risk populations. Recent studies have shown that whereas Ghanaians living in
192 Europe have a higher CKD risk compared to their host nation populations, they have a lower CKD risk
193 compared with their peers living in urban Ghana¹². The increased risk of CKD observed in urban Ghana
194 was not fully explained by conventional risk factors¹² and socio-economic status¹³. This underscores the
195 need to identify other modifiable risk factors of CKD for prevention, optimum treatment and efficient
196 management.

197
198 Evidence shows that where an individual works or stays influences his or her physiological wellbeing
199 leading to an increased risk of chronic diseases^{14 15}. Thus, migrants' physiological wellbeing is influenced
200 by the environment (host nations) they move to stay. The association between PS and CKD as well as the
201 biological pathways through which PS influences CKD progression is poorly understood and complex⁵
202 although several pathways have been suggested^{16 17}. Specifically, PS have been reported to be associated
203 with alteration in the sympathetic/autonomic nervous system activity leading to higher rates of traditional
204 risk factors of CKD including hypertension and diabetes¹⁸⁻²⁰. Environmental stressors have been reported
205 to contribute to the development of insulin resistance, metabolic syndrome, obesity and diabetes which if
206 uncontrolled leads to CKD incidence^{21 22}. Other studies^{23 24} have suggested that stress attributable to social
207 and/or economic disadvantage is associated with CKD development and progression through an interaction
208 between other psychosocial factors and comorbid behaviors such as alcohol, tobacco and drug use²⁵. In
209 addition, undernutrition due to stress adversely impact on fetal environment by impeding fetal growth
210 leading to low birth weight, which has been shown to be associated with CKD in adult life^{25 26}.

211
212 However, studies linking psychosocial stressors (PS) to CKD prevalence and progression vary greatly
213 among different geographical populations.^{5 16 27-31}. Specifically, in the USA whereas no association was
214 found between PS and CKD³¹⁻³³ another study reported lower prevalence of CKD was associated with

1
2
3 215 greater life stressors at baseline³¹. In contrast, in the Netherlands depressive and anxiety symptoms were
4 216 observed to be common among CKD patients and such patients had increased risk of poor clinical outcomes
5 217²⁸. Similarly, a study conducted in Korea reported a positive relationship between depressive symptoms and
6 218 CKD²⁷. These observations suggest differential impact of PS at different geographical locations. For
7 219 example, discrimination among migrants may differ greatly between host population and from their SSA
8 220 compatriots. Specifically, some studies have reported differences in PS among rural and urban populations
9 221³⁴.

14 222 Current literature on the association between PS and CKD among sub-Saharan African populations and
15 223 their migrants in Europe is scanty and uncertain. We therefore sought to determine the association between
16 224 PS and CKD prevalence among Ghanaians in rural and urban Ghana and their migrants living in three
17 225 European cities. Furthermore, we examined the influence of psychosocial stressors on risk factors (obesity,
18 226 diabetes and hypertension) of CKD.

22 227

23 228 **Methods**

24 229

25 230 ***Study population and study design***

26 231

28 232 For this study, data from the Research on Obesity & Diabetes among African Migrants (RODAM) study, a
29 233 multi-centre cross sectional study, were used. The rationale, conceptual framework, design and
30 234 methodology of the RODAM study have been described in detail elsewhere^{12 13 35 36}. To summarize, the
31 235 study was conducted from 2012 to 2015. Ghanaians aged 25–70 years living in rural and urban communities
32 236 in Ghana as well as in three European cities (Amsterdam, Berlin and London) were included in this study.
33 237 We standardized data collection across all sites. The ethics committees in Ghana, the Netherlands, Germany
34 238 and the UK approved the study protocol prior to data collection. Informed consent was obtained from each
35 239 participant prior to enrollment in the study. In Ghana, participants were randomly drawn from a list of 30
36 240 enumeration areas in the Ashanti region based on the 2010 population census. These enumeration areas
37 241 came from both rural areas and two purposively selected urban cities (Kumasi and Obuasi). For Ghanaians
38 242 in Amsterdam, we randomly drew participants from the Municipal register. This register holds data on
39 243 country of birth of citizens and their parents, thus allowing for sampling based on the Dutch standard
40 244 indicator for ethnic origin. London lacked a population register for migrant groups. Thus, Ghanaian
41 245 organizations served as sampling frame for the study. Lists of these organizations were obtained from the
42 246 Ghanaian Embassy and the Association of Ghanaian Churches in the UK in the boroughs known to have
43 247 the greatest concentration of Ghanaians. Members were selected from the lists of all members of these
44 248 organizations. In Berlin, the registration office of the federal state of Berlin provided a list of Ghanaian
45 249 individuals in Berlin but this resulted in low response rate. Because of this, a change was made to use lists

1
2
3 250 of Ghanaian churches and organizations as the sampling frame. Across all sites in Europe, all selected
4 251 participants were sent a written invitation combined with written information (information sheet) regarding
5 252 the study and a response card. The participants were contacted by phone to schedule a date and location of
6 253 the interview with a trained research assistant or opt for the self-administration of the paper questionnaire
7 254 or digital online version depending on the preference of the participant. After the completion of the
8 255 questionnaire, a date for physical examination was then scheduled after a positive response. The participants
9 256 were instructed to fast from 10.00 p.m. the night before the physical examination. The response rate was
10 257 76% in rural Ghana and 74% in urban Ghana. In London, of those individuals who were registered in the
11 258 various Ghanaian organizations and were invited, 75% agreed and participated in the study, while in Berlin,
12 259 this figure was 68%, and 53% in Amsterdam. For the current study, 5898 participants with data available
13 260 on both questionnaire data and physical measurements were used. Individuals who were outside the age
14 261 range of 25–70 years (n=239) were excluded because not all the study sites had individuals outside this age
15 262 range resulting in 5659 individuals comprising of 2492 from rural and urban Ghana and 3167 from the three
16 263 European cities. In the conduct of analysis, we further excluded individuals with no data on CKD and all
17 264 other indicators (n=52), resulting in a data set of 5607 participants for analysis.

265 266 **Measurements**

267 268 **Covariates**

269 *Demographic and lifestyle factors*

270 For this study, we obtained information on demographics, educational level and lifestyle factors (smoking
271 and physical activity) by questionnaire. Physical examinations were performed across all sites using
272 validated devices per standardized operational procedures. Weight was measured in light clothing and
273 without shoes with SECA 877 scales to the nearest 0.1 kg. Height was measured without shoes with a
274 portable stadiometer (SECA 217) to the nearest 0.1 cm. Body mass index (BMI) was calculated as weight
275 (kg) divided by height squared (m²). Overweight was defined as BMI of 25 to < 30 kg/m² and obesity as
276 BMI \geq 30 kg/m². Waist circumference was measured in centimetres at the midpoint between the lower rib
277 and the upper margin of the iliac crest. We used the same assessor for each participant in measuring all
278 anthropometrics and each was measured twice; the average of the two measurements was used for analyses.

279 *Predictor: SS*

280 For this study, four constructs of psychosocial stress (discrimination, perceived stress at work or at home,
281 negative life events and depressive symptoms) were used as explanatory variables.

282 *Perceived discrimination*

1
2
3 283 Everyday discrimination as perceived by participants was reported as routinely experiencing instances of
4 284 unfair treatment. We used the the Everyday Discrimination Scale (EDS). The EDS comprises of a 9-items
5 285 which rates the frequency at which participants experience daily mistreatment and it focuses on being
6 286 treated with less courtesy or less respect, receiving poorer service than other people or being called names
7 287 or insulted. Participants had the option of rating each of the 9-items from “never” = 1 to “very often” = 5.
8 288 The obtained scores were summed and an average of the scores was computed to obtain a final score of 1
9 289 to 5. This scale was used because it is commonly used for self-reported discrimination ³⁷, with consistent
10 290 high reliability among a variety of ethnicities ³⁸, comprising African migrants in the Netherland ³⁹.

17 291 *Perceived stress at work or at home*

18 292 We defined perceived stress at work or at home as “sense of irritation, filled with anxiety, or as having
19 293 difficulties in sleeping because of circumstances at work or at home”. We used the psychological stress
20 294 scale created by the INTERHEART study ⁴⁰. Participants in the study were asked about their opinion on
21 295 frequency of stress at work and at home, and could answer “never”, “some periods”, “several periods”, or
22 296 “continually”. Both answers were then combined into a composite score and graded into four categories:
23 297 never experienced to experienced permanent stress at home or at work ⁴⁰. Due to the very small numbers in
24 298 the permanent periods of stress group, we combined experienced several periods of stress at home or at
25 299 work and permanent periods of stress at home or at work.

32 302 *Negative life events*

34 303 The presence of major negative life events among participants was perceived as any event that could cause
35 304 acute stress to an individual. We therefore applied the well-validated and widely used List of Threatening
36 305 Experiences (LTE) ^{41 42}. The scale comprised of 12 unpleasant events participants perceived to have
37 306 experienced in the past 12 months. We used a slightly-altered version of LTE consisting of 9 unpleasant
38 307 items. We dichotomized participants into two groups namely “no negative life events” and “one or more
39 308 events” and participants in the second category were expected to have higher levels of stress ⁴².

45 309 *Depressive symptoms*

47 310 Depressive symptoms were measured by the 9-item Patient Health Questionnaire (PHQ-9). The PHQ-9
48 311 consists of nine items, with a response scales 0 ‘not at all’, 1 ‘on several days’, 2 ‘on more than half of the
49 312 days’ and 3 ‘nearly every day’. A participant was considered to be in a significant depressed mood (SDM)
50 313 when one or both of the items 1 (little interest or pleasure in doing things) and 2 (feeling down, depressed,
51 314 or hopeless) were answered with at least ‘on more than half of the days’, and at least 5 of the 9 items were
52 315 answered with at least ‘on more than half of the days’⁴³.

316 ***Co-morbidity factors***

317 Blood pressure (BP) was measured three times using a validated semi-automated device (The Microlife
318 WatchBP home) with appropriate cuffs in a sitting position after at least 5min rest. The mean of the last
319 two BP measurements was used in the analyses. Hypertension was defined as systolic BP 140mmHg and/or
320 diastolic BP 90mmHg, and/or being on antihypertensive medication treatment, and/or self-reported
321 hypertension. Trained research assistants in all sites collected fasting venous blood samples according to
322 standard operation procedures, and then temporarily stored at the local research location. The stored blood
323 samples from the local research centres were transported to Berlin, Germany, according to standardized
324 procedures, for biochemical analyses. This was done to avoid intra-laboratory variability. Fasting plasma
325 glucose concentration was measured using an enzymatic method (hexokinase). We defined Type 2 diabetes
326 according to the World Health Organization diagnostic criteria (fasting glucose 7.0mmol/L, and/or current
327 use of medication prescribed to treat diabetes, and/or self-reported diabetes) ⁴⁴. We assessed concentration
328 of total cholesterol using colorimetric test kits. All biochemical analyses were performed using an ABX
329 Pentra 400 Chemistry Analyzer (ABX Pentra; Horiba 90 ABX, Germany). Hypercholesterolaemia was
330 defined as total cholesterol level ≥ 6.22 mmol/L. Serum creatinine concentration (in mol/L) was determined
331 by a kinetic colorimetric spectrophotometric isotope dilution mass spectrometry calibration method (Roche
332 Diagnostics).

333 **Outcome: CKD prevalence**

334 We asked participants to bring an early morning urine sample for the analyses of albuminuria and creatinine
335 levels. Urinary albumin concentration (in μ mol/L) was measured by an immunochemical turbidimetric
336 method (Roche Diagnostics). Urinary creatinine concentration (in μ mol/L) was measured by a kinetic
337 spectrophotometric method (Roche Diagnostics). Extensive quality checks were done inclusive of blinded
338 serial measurements. Estimated glomerular filtration rate (eGFR) was calculated using the CKDEPI (CKD
339 Epidemiology Collaboration) creatinine equation ⁴⁵. Urinary albumin–creatinine ratio (ACR; expressed in
340 mg/mmol) was calculated by taking the ratio between urinary albumin and urinary creatinine. eGFR and
341 albuminuria were categorized according to the 2012 KDIGO classification ⁴⁶. eGFR was categorized as
342 follows: G1, 90mL/min/1.73m² (normal kidney function); G2, 60–89mL/min/1.73m² (mildly decreased);
343 G3a, 45–59mL/min/1.73m² (mildly to moderately decreased); G3b, 30–44mL/min/1.73m² (moderately to
344 severely decreased); G4, 15–29 mL/min/1.73 m² (severely decreased); and G5, <15mL/min/1.73m² (kidney
345 failure). Albuminuria categories were derived from ACR and were as follows: A1, < 3mg/mmol (normal
346 to mildly increased); A2, 3–30mg/mmol (moderately increased); and A3, > 30mg/mmol (severely
347 increased). CKD status was categorized according to severity of kidney disease (green, low risk; yellow,
348 moderately increased risk; orange, high risk; and red, very high risk) using the combination of eGFR (G1–

349 G5) and albuminuria (A1–A3) levels defined by the 2012 KDIGO guideline⁴⁷. Due to the small number of
350 participants in the very high-risk category of CKD (n=27), the high and very high-risk groups were
351 combined. Because of the small number of participants in the severely increased albuminuria category (A3,
352 n=62), we defined albuminuria as ACR 3mg/ mmol by combining the moderately increased (A2) and
353 severely increased (A3) categories.

354
355 Covariates assessed were age, sex, educational level and length of stay in Europe, hypertension and
356 diabetes. Length of stay was assessed for Ghanaian migrants only. Length of stay was defined as the number
357 of years lived in Europe at the time of data collection. Length of stay was controlled for due to evidence
358 suggesting that it influences mental health⁴⁸. Other covariates were hypertension, obesity and diabetes.

359 360 ***Patient and Public Involvement***

361 Community leaders were involved in the recruitment of patients. These comprised of religious communities
362 (churches and mosques), endorsement from local key leaders and establishing relationships with healthcare
363 organizations. We also provided information on the study by involving the local media (radio and television
364 stations). We sent letters to all selected health and community authorities to notify participants of the study.
365 Team members were sent to the various communities to stay among the community and organize mini
366 clinics for a period of 1-2 weeks. Results of the study were disseminated through seminars, durbars and via
367 radio and television stations.

368 ***Statistical methods***

369 Characteristics of participants were expressed as absolute numbers and percentages for categorical variables
370 and means and standard deviations for continuous variables. The z-test was used to compare proportions of
371 demographic and clinical variables among the various sites and the independent t-test was also used to test
372 for mean differences between the two sites. Odds Ratios (ORs) and their corresponding 95% confidence
373 intervals (CIs) were estimated by means of binary logistic regression analyses to study the associations of
374 albuminuria (ACR>3 mg/mmol, A2-A3, moderately to severely increased albuminuria), reduced kidney
375 function (eGFR< 60 mL/min/1.73m², G3-G5 moderately to severely decreased kidney function) and
376 increased CKD risk (high and very high CKD risk), with adjustments for covariates⁴⁹. The Spearman's
377 correlation test was used to test for associations between all four constructs of PS. Three models were used
378 to examine the data. Model 1 was adjusted for age and sex, model 2 was adjusted for age and sex and
379 educational level for Ghanaians living in SSA while age, sex, educational level and length of stay for
380 Ghanaians living in Europe⁵⁰⁻⁵². Model 3 was adjusted for sex, age, educational level and conventional risk
381 factors (hypertension, diabetes, hypercholesterolemia, BMI, physical activity and smoking status) of CKD.

1
2
3 382 The analyses were performed for all 4 constructs of PS using individuals who have not experienced either
4 383 of the PS per outcome as reference. All tests were stratified per sites due to interactions, Ghanaians living
5 384 in SSA and Europe; Ghanaians living in rural and urban Ghana and Ghanaians living in Amsterdam, Berlin
6 385 and London due to an observed interaction between PS and site. Furthermore, the analyses were stratified
7 386 for those with and without obesity, diabetes, hypertension across all sites. P-values less than 0.05 were
8 387 interpreted as statistically significant. All analyses were performed using STATA, version 14.0 (StataCorp
9 388 LP).

15 389 **Results**

17 390 *Characteristics of the study population*

18 391
19 392 Participants characteristics are shown in Table 1. Ghanaians living in Ghana were significantly older than
20 393 their peers living in Europe (47.7±11.9 versus 46.6±9.9, p=0.006). There were more female participants in the
21 394 Ghana sample compared with European sample (67.1% versus 58.5%, p=0.001). Ghanaians living in
22 395 Ghana were significantly less educated than those living in Europe. Higher proportion of Ghanaians living
23 396 in Ghana had experienced negative life events in the last 12 months compared with their peers living in
24 397 Europe (68.7% versus 59.0%, p=0.001). More than half of Ghanaians living in Ghana had experienced
25 398 some stress at home or work whereas only a third of those living in Europe had experienced some stress at
26 399 home or work (p=0.001). Permanent stress at home/work was fairly the same among Ghanaians living in
27 400 SSA and Europe. Perceived discrimination was significantly higher among Ghanaians living in Europe
28 401 compared with their peers living in Ghana (29.7% versus 4.8%, p=0.001). Depressive symptoms were more
29 402 prevalent among Ghanaians living in Europe 7.5% compared with their peers living in Ghana 5.1%. Almost
30 403 all Ghanaians living in Europe were first generation migrants. Ghanaians in Europe were significantly more
31 404 obese, more likely to smoke and less physically active compared with their peers living in Ghana.
32 405 Prevalence of hypercholesterolemia was significantly higher, but type 2 diabetes and hypertension were
33 406 significantly lower among Ghanaians living in Ghana compared with their peers living in Europe (p=0.001).
34 407 Prevalence of albuminuria, reduced eGRF and CKD risk were higher in Ghanaians living in Ghana
35 408 compared with those living in Europe.

36 409

37 410

38 411

39 412

413 **Table 1: Baseline characteristics of respondents**

	Ghanaians (SSA) n (%)	Ghanaians (Europe) n (%)	p-value
N	2,492 (44.1)	3,167 (55.9)	0.001
Female sex	1672 (67.1)	1,851 (58.5)	0.001
Age (years)	47.7±11.9	46.6±9.9	0.006
Educational status			
Low	1169 (49.2)	635 (21.8)	0.001
Middle	858 (36.1)	1111 (38.1)	
High	347 (14.6)	1168 (40.1)	
Negative life events in the past 12 months			
No	739 (31.3)	1158 (41.0)	0.001
Yes	1619 (68.7)	1667 (59.0)	
Perceived stress at home/work			
Never	692 (29.4)	1371 (48.8)	0.001
Some periods	1290 (54.7)	1033 (36.8)	
Several/Permanent	375 (15.9)	407 (14.4)	
Perceived discrimination			
No	2065 (95.2)	1960 (70.3)	0.001
Yes	104 (4.8)	829 (29.7)	
Depressive symptoms			
No	2239 (94.9)	2582 (92.5)	0.001
Yes	119 (5.1)	209 (7.5)	
Migration generation			
First	Not applicable	2868 (98.7)	Not applicable
Second	Not applicable	38 (1.3)	Not applicable
BMI			
Normal (<25kg/m ²)	1373 (55.2)	643 (20.4)	0.001
Overweight (25 ≤ 30kg/m ²)	684 (27.5)	1,350 (42.8)	

Obese (>30kg/m ²)	432 (17.3)	1163 (36.8)	
Currently smoking	36 (1.5)	121 (4.1)	0.001
Physical activity	1255 (52.8)	1131 (44.0)	0.001
Hypocholesteraemia	352 (14.2)	354 (11.3)	0.007
Type 2 diabetes	206 (8.3)	444 (14.0)	0.001
Hypertension	837 (33.6)	1801 (56.9)	0.001
ACR			
A1 < 3mg/mmol	2215 (90.2)	2814 (91.8)	0.001
A2-A ≥ 3mg/mmol	243 (9.8)	252 (8.2)	
eGFR			
G1-G2 ≥ 60 mL/min/1.73 m ²	2377 (96.3)	2936 (97.4)	0.018
G3a-G5 < 60 mL/min/1.73 m ²	85 (3.7)	78 (2.6)	
CKD Risk			
Low risk	2197 (89.6)	2705 (91.5)	0.015
Moderate-very high risk	256 (10.4)	252 (8.5)	

Abbreviations: N, number of respondents; BMI, body mass index; eGFR, estimated glomerular filtration rate; G1-G2, normal to high kidney function to mildly decreased; G3a-G5, mildly to moderately decreased to Kidney failure; ACR, albumin creatinine ratio; A1, normal to mildly increased; A2-A3, moderately increased to severely increased; CKD, Chronic kidney disease; SSA, Sub-Saharan Africa; CI, confidence intervals.

420 *Association between PS and CKD*

421 Figure 1-4 shows CKD prevalence by negative life events in the past 12 months among Ghanaians living
 422 in Ghana and Europe. In Europe, CKD prevalence was fairly the same among those who had experienced
 423 any negative life events compared with those who had not in the last 12 months. Prevalence of CKD was
 424 higher among Ghanaians who had not experienced any negative life events in the past 12 months (10.9%)
 425 compared with those who had experienced some negative life events (9.9%) and living in Ghana. CKD
 426 prevalence was higher among Ghanaians who had not experienced any form of discrimination (10.6%) than
 427 those who had (6.7%) in Ghana as well as in Europe (Figure 2). CKD prevalence was slightly higher among
 428 Ghanaians who had experienced several/permanent stress at work/home in the past 12 months and living
 429 in Ghana (10.4%) or Europe (9.7%) (Figure 3). Ghanaians who did not report any form of depressive
 430 symptoms had a significantly higher CKD prevalence than those who did and living in Ghana (10.4%) and
 431 Europe (8.7%) (Figure 4).

433 Table 2 shows the correlation matrix between the 4 constructs of PS among Ghanaians living in Ghana and
 434 those living in Europe. All four constructs of PS were positively correlated with each other among
 435 Ghanaians living in Europe and Ghanaians living in Ghana ($p < 0.001$), except stress at work/home and
 436 discrimination among Ghanaians living in Ghana.

437
 438 **Table 2: Relationship between PS constructs (negative life events, discrimination, stress at**
 439 **work or home and depression) by Ghanaians (SSA) and Ghanaians (Europe)**

Correlation matrix	Negative events	Discrimination	Stress at work/home	Depression
Europe				
Negative events	1.000			
Discrimination	0.152**	1.000		
Stress at work/home	0.297**	0.161**	1.000	
Depressive symptoms	0.143**	0.136**	0.285**	1.000
Ghana				
Negative events	1.000			
Discrimination	0.079**	1.000		
Stress at work/home	0.101**	-0.032	1.000	
Depressive symptoms	0.091**	0.042	0.185**	1.000

442 ****Significant at 1%, Spearman's correlation**

444 Table 3 shows association between all 4 constructs of PS and CKD among Ghanaians living in Ghana and
 445 those living in Europe. There was no statistically significant association between PS and albuminuria,
 446 reduced eGFR and CKD risk among Ghanaians living in Ghana and those living in Europe except
 447 individuals living in Europe with some stress and lower risk of reduced eGFR (0.46, 95% C.I. 0.24-0.88).
 448 Table S1 shows further adjustments for conventional risk factors of CKD. This did not show any
 449 statistically significant associations between PS and albuminuria, reduced eGFR and CKD risk
 450 among Ghanaians living in Ghana and Europe (Table S1). Table S2 shows further stratification
 451 based on obesity status. We did not find any association between PS and CKD for obese participants and
 452 those who were not obese for Ghanaians living in rural and urban Ghana and those living in Europe.
 453 However, we observed an inverse association between PS and CKD among migrants who were not obese
 454 but have experienced discrimination for the past 12 months (0.63 95% C.I. 0.41-0.97) (Table S2). In Table
 455 S3 we stratified our analysis based on diabetic status. We did not find any associations between PS and

1
2
3 456 CKD for participants with and without diabetes for both Ghanaians living in rural and urban Ghana and
4
5 457 their migrant peers in Europe (Table S3). Finally, Table S4 stratified analysis by hypertension status. No
6
7 458 associations were observed between PS and CKD for individuals who had hypertension and those who did
8
9 459 not have hypertension for both those living in rural and urban Ghana as well as their compatriots living in
10
11 460 Europe. An inverse association was observed between PS and CKD among Ghanaians who have
12
13 461 experienced discrimination in the last 12 months with no hypertension and living in Europe (0.51, 95% C.I.
14
15 462 0.27-0.97). Also, we observed that having experienced some stress at home/work was inversely associated
16
17 463 with reduced eGFR among Ghanaians with hypertension and living in Europe (0.47, 95% C.I. 0. 0.23-0.95)
18
19 464 (Table S4).
20
21 465
22
23 466
24
25 467
26
27 468
28
29 469
30
31 470
32
33 471
34
35 472
36
37 473
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

474

475 **Table 3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with**
 476 **albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe**

477

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe									
No	1128 (8.2)	1.00 (Reference)	1.00 (Reference)	1106 (2.6)	1.00 (Reference)	1.00 (Reference)	1090 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	1615 (8.4)	1.03 (0.78-1.35)	1.07 (0.80-1.42)	1587 (2.5)	0.86 (0.53-1.42)	0.83 (0.49-1.39)	1557 (8.6)	0.97 (0.76-1.32)	0.99 (0.74-1.32)
Ghana									
No	732 (8.7)	1.00 (Reference)	1.00 (Reference)	736 (4.5)	1.00 (Reference)	1.00 (Reference)	732 (10.9)	1.00 (Reference)	1.00 (Reference)
Yes	1595 (3.8)	0.87 (0.65-1.16)	0.85 (0.63-1.14)	1601 (3.4)	0.69 (0.45-1.08)	0.67 (0.44-1.09)	1590 (9.9)	0.88 (0.66-1.17)	0.86 (0.64-1.15)
Discrimination									
Europe									
No	1899 (8.5)	1.00 (Reference)	1.00 (Reference)	1867 (2.6)	1.00 (Reference)	1.00 (Reference)	1832 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	810 (7.4)	0.87 (0.64-1.19)	0.92 (0.67-1.26)	791 (2.2)	0.83 (0.47-1.47)	0.84 (0.46-1.52)	782 (7.3)	0.82 (0.59-1.12)	0.84 (0.60-1.16)
Ghana									
No	2034 (10.0)	1.00 (Reference)	1.00 (Reference)	2047 (3.9)	1.00 (Reference)	1.00 (Reference)	2031 (10.6)	1.00 (Reference)	1.00 (Reference)
Yes	104 (7.7)	0.83 (0.39-1.73)	0.91 (0.67-1.24)	104 (1.9)	0.67 (0.15-2.85)	0.67 (0.16-2.84)	104 (6.7)	0.70 (0.32-1.55)	0.71 (0.32-1.55)
Stress at home/work									
Europe									
Never	1330 (8.2)	1.00 (Reference)	1.00 (Reference)	1305 (3.4)	1.00 (Reference)	1.00 (Reference)	1282 (8.5)	1.00 (Reference)	1.00 (Reference)
Some stress	1002 (7.9)	0.97 (0.72-1.31)	1.04 (0.76-1.42)	984 (1.4)	0.47 (0.26-0.87)	0.46 (0.24-0.88)	968 (8.6)	0.96 (0.71-1.30)	1.02 (0.74-1.39)
Several/Permanent stresses	397 (9.1)	1.11 (0.74-1.64)	1.153 (0.77-1.72)	390 (2.3)	0.73 (0.35-1.52)	0.76 (0.36-1.61)	383 (9.7)	1.13 (0.77-1.68)	1.19 (0.80-1.79)
Ghana									
Never	682 (10.3)	1.00 (Reference)	1.00 (Reference)	688 (3.3)	1.00 (Reference)	1.00 (Reference)	682 (9.9)	1.00 (Reference)	1.00 (Reference)

1										
2										
3	Some stress	1279 (9.5)	0.87 (0.64-1.19)	0.80 (0.59-1.11)	1279 (3.9)	1.06 (0.63-1.77)	1.11 (0.66-1.87)	1274 (10.3)	0.95 (0.69-1.30)	0.92 (0.67-1.26)
4	Several/Permanent stresses	365 (8.5)	0.75 (0.48-1.18)	0.68 (0.59-1.11)	369 (4.1)	1.13 (0.57-2.23)	1.22 (0.61-2.46)	365 (10.4)	0.96 (0.63-1.47)	0.92 (0.59-1.42)
5										
6	Depressive symptoms									
7										
8	Europe									
9										
10	No	2505 (8.5)	1.00 (Reference)	1.00 (Reference)	2457 (2.7)	1.00 (Reference)	1.00 (Reference)	2416 (8.7)	1.00 (Reference)	1.00 (Reference)
11	Yes	206 (6.3)	0.71 (0.39-1.27)	0.76 (0.43-1.36)	202 (1.5)	0.63 (0.19-2.03)	0.68 (0.21-2.23)	199 (7.1)	0.78 (0.44-1.37)	0.83 (0.47-1.46)
12										
13	Ghana									
14	No	2212 (9.9)	1.00 (Reference)	1.00 (Reference)	2222 (3.8)	1.00 (Reference)	1.00 (Reference)	2207 (10.4)	1.00 (Reference)	1.00 (Reference)
15	Yes	114 (5.3)	0.45 (0.19-1.03)	0.45 (0.19-1.01)	114 (2.6)	0.52 (0.16-1.72)	0.53 (0.17-1.74)	114 (7.9)	0.62 (0.30-1.25)	0.61 (0.30-1.24)

16 **478** Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR,
 17 **479** albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels
 18 **480** of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe

1
2
3 481 Table 4 shows associations between all 4 constructs of PS and CKD stratified by Ghanaians living
4
5 482 in urban and rural Ghana. There was no association between PS and albuminuria, reduced eGFR
6
7 483 and CKD risk among Ghanaians living rural and urban Ghana.
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

484

485 **Table 4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depressive symptoms) with**
 486 **albuminuria, reduced eGFR and CKD risk among rural and urban Ghana**

487

488

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Urban Ghana									
No	477 (11.9)	1.00 (Reference)	1.00 (Reference)	477 (4.4)	1.00 (Reference)	1.00 (Reference)	477 (12.2)	1.00 (Reference)	1.00 (Reference)
Yes	912 (10.5)	0.87 (0.61-1.23)	0.87 (0.61-1.24)	911 (3.4)	0.73 (0.41-1.31)	0.72 (0.40-1.29)	910 (10.8)	0.87 (0.61-1.24)	0.87 (0.61-1.25)
Rural Ghana									
No	255 (7.5)	1.00 (Reference)	1.00 (Reference)	259 (4.6)	1.00 (Reference)	1.00 (Reference)	255 (8.6)	1.00 (Reference)	1.00 (Reference)
Yes	683 (7.6)	0.97 (0.56-1.69)	0.94 (0.54-1.64)	690 (3.5)	0.63 (0.31-1.31)	0.66 (0.32-1.37)	680 (8.8)	0.93 (0.55-1.58)	0.92 (0.54-1.56)
Discrimination									
Urban Ghana									
No	1326 (11.1)	1.00 (Reference)	1.00 (Reference)	1326 (3.9)	1.00 (Reference)	1.00 (Reference)	1325 (11.4)	1.00 (Reference)	1.00 (Reference)
Yes	71 (8.5)	0.85 (0.36-2.00)	0.89 (0.37-2.11)	71 (2.8)	1.17 (0.27-2.09)	1.16 (0.27-2.06)	71 (7.1)	0.69 (0.27-1.77)	0.72 (0.28-1.83)
Rural Ghana									
No	708 (8.1)	1.00 (Reference)	1.00 (Reference)	721 (3.9)	1.00 (Reference)	1.00 (Reference)	706 (9.2)	1.00 (Reference)	1.00 (Reference)
Yes	33 (6.1)	0.79 (0.18-3.47)	0.84 (0.19-2.65)	33 (0.0)	***	***	33 (6.1)	0.75 (0.17-2.89)	0.83 (0.19-2.65)
Stress at home/work									
Urban Ghana									
Never	460 (10.9)	1.00 (Reference)	1.00 (Reference)	460 (3.3)	1.00 (Reference)	1.00 (Reference)	460 (10.2)	1.00 (Reference)	1.00 (Reference)
Some stress	732 (11.5)	1.04 (0.71-1.51)	0.91 (0.62-1.37)	730 (4.1)	1.27 (0.66-2.43)	1.30 (0.67-2.51)	730 (11.8)	1.13 (0.77-1.65)	1.04 (0.71-1.53)
Several/Permanent stresses	197 (9.6)	0.87 (0.50-1.52)	0.74 (0.42-1.02)	198 (3.5)	1.17 (0.46-2.84)	1.20 (0.47-3.09)	197 (11.7)	1.15 (0.68-1.71)	1.05 (0.61-1.81)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Rural Ghana

Never	222 (9.0)	1.00 (Reference)	1.00 (Reference)	228 (3.5)	1.00 (Reference)	1.00 (Reference)	222 (9.5)	1.00 (Reference)	1.00 (Reference)
Some stress	547 (6.9)	0.69 (0.39-1.23)	0.68 (0.38-1.22)	549 (3.6)	0.88 (0.38-2.07)	0.92 (0.39-2.18)	544 (8.3)	0.74 (0.42-1.30)	0.75 (0.42-1.31)
Several/Permanent stresses	168 (7.1)	0.63 (0.30-1.37)	0.60 (0.28-1.29)	171 (4.7)	1.07(0.38-3.03)	1.21(0.43-3.46)	168 (8.9)	0.71 (0.34-1.50)	0.73 (0.35-1.50)

Depressive symptoms

Urban Ghana

No	1336 (11.3)	1.00 (Reference)	1.00 (Reference)	1335 (3.8)	1.00 (Reference)	1.00 (Reference)	1334 (11.5)	1.00 (Reference)	1.00 (Reference)
Yes	52 (3.9)	0.30 (0.07-1.25)	0.30 (0.07-1.27)	52 (1.9)	0.46 (0.06-2.50)	0.45 (0.06-2.13)	52 (5.8)	0.44 (0.14-1.45)	0.45 (0.14-1.48)

Rural Ghana

No	876 (7.7)	1.00 (Reference)	1.00 (Reference)	887 (3.8)	1.00 (Reference)	1.00 (Reference)	873 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	62 (6.5)	0.67 (0.23-1.94)	0.67 (0.23-1.94)	62 (3.2)	0.58 (0.13-2.56)	0.61 (0.14-2.68)	62 (9.7)	0.82 (0.33-2.01)	0.85 (0.34-2.09)

489 Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration
490 rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in urban and rural Ghana among the various levels of PS constructs; %, proportion of individuals with CKD
491 among the various levels of PS constructs in rural and urban Ghana. ***, no case of CKD and therefore odds ratios were not calculated

1
2
3 508 Table 5 shows associations between all 4 constructs of PS and CKD stratified by Ghanaians living in
4 509 Amsterdam, Berlin and London. There were no associations between PS and albuminuria, reduced eGFR
5 510 and CKD risk among Ghanaians living in Europe except for positive association between stress at
6 511 work/home and albuminuria (2.81, 95% C.I. 1.46-5.40) and CKD risk (2.78, 95% C.I. 1.43-5.43) among
7 512 Ghanaians living in Berlin.
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

513

514 **Table 5: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depressive symptoms) with**
 515 **albuminuria, reduced eGFR and CKD risk among Ghanaians in three European cities.**

516

517

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Amsterdam									
No	548 (7.3)	1.00 (Reference)	1.00 (Reference)	534 (2.4)	1.00 (Reference)	1.00 (Reference)	521 (7.5)	1.00 (Reference)	1.00 (Reference)
Yes	784 (7.8)	1.08 (0.71-1.63)	1.18 (0.77-1.81)	764 (2.9)	1.11 (0.55-2.23)	1.15 (0.55-2.37)	742 (8.0)	1.06 (0.69-1.62)	1.08 (0.71-1.66)
Berlin									
No	213 (9.9)	1.00 (Reference)	1.00 (Reference)	213 (2.4)	1.00 (Reference)	1.00 (Reference)	213 (10.8)	1.00 (Reference)	1.00 (Reference)
Yes	329 (10.9)	1.12 (0.63-1.99)	1.19 (0.67-2.15)	330 (1.8)	0.64 (0.19-2.17)	0.61 (0.18-2.11)	329 (9.4)	0.86 (0.48-1.52)	0.91 (0.51-1.63)
London									
No	367 (8.7)	1.00 (Reference)	1.00 (Reference)	359 (3.1)	1.00 (Reference)	1.00 (Reference)	356 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	502 (7.8)	0.89 (0.55-1.46)	0.83 (0.49-1.41)	493 (2.2)	0.68 (0.28-1.65)	0.58 (0.22-1.51)	486 (9.1)	1.04 (0.64-1.68)	0.99 (0.58-1.68)
Discrimination									
Amsterdam									
No	956 (8.3)	1.00 (Reference)	1.00 (Reference)	935 (2.9)	1.00 (Reference)	1.00 (Reference)	909 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	363 (5.0)	0.59 (0.34-1.00)	0.59 (0.35-1.02)	349 (2.1)	0.69 (0.30-1.62)	0.81 (0.34-1.91)	342 (5.9)	0.69 (0.41-1.14)	0.69 (0.41-1.16)
Berlin									
No	329 (10.0)	1.00 (Reference)	1.00 (Reference)	329 (2.1)	1.00 (Reference)	1.00 (Reference)	329 (10.3)	1.00 (Reference)	1.00 (Reference)
Yes	209 (11.0)	1.11 (0.63-1.95)	1.16 (0.65-2.05)	210 (1.9)	0.83 (0.24-2.93)	0.82 (0.23-2.91)	209 (9.1)	0.86 (0.48-1.56)	0.89 (0.49-1.63)
London									
No	614 (7.9)	1.00 (Reference)	1.00 (Reference)	603 (2.5)	1.00 (Reference)	1.00 (Reference)	594 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	238 (7.9)	1.03 (0.59-1.81)	1.18 (0.65-2.15)	232 (2.6)	1.29 (0.46-3.59)	1.09 (0.35-3.43)	231 (7.8)	0.93 (0.53-1.63)	0.98 (0.52-1.82)
Stress at home/work									

1										
2										
3										
4	Amsterdam									
5	Never	634 (8.4)	1.00 (Reference)	1.00 (Reference)	622 (3.2)	1.00 (Reference)	1.00 (Reference)	603 (8.0)	1.00 (Reference)	1.00 (Reference)
6	Some stress	478 (5.7)	0.68 (0.42-1.11)	0.69 (0.42-1.13)	462 (1.9)	0.64 (0.29-1.43)	0.68 (0.30-1.52)	452 (6.0)	0.74 (0.45-1.20)	0.74 (0.45-1.22)
7	Several/Permanent stresses	210 (9.1)	1.09 (0.63-1.91)	1.12 (0.64-1.95)	204 (2.5)	0.71 (0.26-1.95)	0.77 (0.28-2.14)	198 (10.1)	1.24 (0.71-2.14)	1.26 (0.73-2.20)
8										
9	Berlin									
10	Never	250 (9.0)	1.00 (Reference)	1.00 (Reference)	250 (2.0)	1.00 (Reference)	1.00 (Reference)	250 (6.4)	1.00 (Reference)	1.00 (Reference)
11	Some stress	196 (15.3)	2.50 (1.33-4.71)	2.81 (1.46-5.40)	197 (1.5)	0.88 (0.20-3.79)	0.83 (0.19-3.62)	196 (14.8)	2.57 (1.34-4.90)	2.78 (1.43-5.43)
12	Several/Permanent stresses	96 (10.4)	1.64 (0.72-3.73)	1.69 (0.73-3.91)	197 (3.1)	2.10 (0.47-9.46)	2.04 (0.44-9.26)	76 (9.4)	1.52 (0.65-3.58)	1.58 (0.66-3.75)
13										
14										
15										
16	London									
17	Never	446 (9.2)	1.00 (Reference)	1.00 (Reference)	433 (4.4)	1.00 (Reference)	1.00 (Reference)	429 (10.5)	1.00 (Reference)	1.00 (Reference)
18	Some stress	328 (7.0)	0.73 (0.43-1.25)	0.79 (0.44-1.40)	325 (0.6)	0.17 (0.04-0.73)	0.09 (0.01-0.67)	320 (6.9)	0.65 (0.38-1.10)	0.66 (0.37-1.19)
19	Several/permanent stresses	91 (7.7)	0.81 (0.35-1.87)	0.86 (0.35-2.14)	90 (1.1)	0.27 (0.03-2.12)	0.24 (0.03-2.05)	74 (8.9)	0.83 (0.38-1.83)	0.92 (0.39-2.16)
20										
21										
22	Depressive symptoms									
23										
24	Amsterdam									
25	No	1199 (7.8)	1.00 (Reference)	1.00 (Reference)	1135 (2.8)	1.00 (Reference)	1.00 (Reference)	1135 (7.9)	1.00 (Reference)	1.00 (Reference)
26	Yes	121 (6.6)	0.81 (0.39-1.72)	0.83 (0.39-1.76)	118 (1.7)	0.65 (0.15-2.77)	0.71 (0.16-3.06)	116 (6.9)	0.83 (0.39-1.76)	0.82 (0.38-1.74)
27										
28	Berlin									
29	No	503 (10.7)	1.00 (Reference)	1.00 (Reference)	504 (2.2)	1.00 (Reference)	1.00 (Reference)	503 (10.1)	1.00 (Reference)	1.00 (Reference)
30	Yes	34 (5.9)	0.53 (0.12-2.27)	0.49 (0.11-2.13)	34 (0.0)	***	***	34 (5.9)	0.55 (0.13-2.37)	0.52 (0.12-2.24)
31										
32	London									
33	No	803 (8.3)	1.00 (Reference)	1.00 (Reference)	785 (2.6)	1.00 (Reference)	1.00 (Reference)	778 (8.9)	1.00 (Reference)	1.00 (Reference)
34	Yes	51 (5.9)	0.67 (0.20-2.21)	0.91 (0.27-3.07)	50 (2.0)	0.91 (0.11-7.43)	1.15 (0.14-9.54)	49 (8.2)	0.94 (0.33-2.69)	1.30 (0.44-3.81)
35										
36	518	Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, educational level and length of stay; Abbreviations: CI, confidence interval; ACR, albumin creatinine ratio; eGFR, estimated								
37	519	glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Amsterdam, Berlin and London among the various levels of PS constructs; %, proportion								
38	520	of individuals with CKD among the various levels of PS constructs in Europe ***; no case of CKD and therefore odds ratios were not calculated.								
39										
40										
41										
42										
43										
44										
45										
46										
47										

521 **Discussion**

522 **Key findings**

523 Whereas there was an association between those who have experienced some stress at home/work and
524 reduced eGFR among Ghanaians living in Europe, we did not find any association between PS and CKD
525 among Ghanaians living in rural and urban Ghana and their peers in Europe. Also, PS was not associated
526 with CKD for those living in rural and urban Ghana and neither for those living in the three European cities.
527 However, there was an association between stress at work/home and albuminuria and CKD risk among
528 Ghanaians living in Berlin. Further adjustment for conventional risk factors of CKD yielded similar results.

531 **Discussion of key findings**

532 **Association between PS and CKD in Ghana**

533 Our study did not find any association between any of the four constructs of PS and prevalence of CKD
534 (albuminuria, reduced eGFR and CKD risk) among Ghanaians living in rural and urban Ghana. Our findings
535 are however in contrast with earlier studies which reported positive associations between PS and prevalent
536 of CKD^{28 31 53}. Other studies have hypothesised that the influence of PS on CKD may be important in only
537 those with hypertension and diabetes and that PS may mediate or moderate the association between renal
538 functioning and lifestyle behaviours such as smoking and physical activity³³. For example, they argue that
539 stress enhances Sympathetic Nervous System (SNS) activity to increase glucocorticoid secretion and
540 inflammatory cytokines, which heavily contribute to hypertension, diabetes and vascular disease, which are
541 major risk factors of CKD incidence and prevalence⁵⁴. The lack of association between PS and CKD in
542 this present study is unclear due to lack of literature on the association between PS and CKD prevalence
543 particularly in rural and urban populations. Worth noting, however, is the presence of rich family support
544 systems in the Ghanaian context especially in rural Ghana, which may help individuals with CKD to cope
545 with PS thereby minimizing its effect. For example, patients with limited social networks and low social
546 support have been shown to have augmented risk of morbidity and mortality⁵⁵⁻⁵⁷. Specifically, there is
547 evidence that positive social support is a protective factor for persons dealing with long-term disease
548 conditions⁵⁸. Other studies have reported a protective relationship between social networks, emotionally
549 supportive relationship and threats to physiological and psychosocial health⁵⁹.

552 **Association between PS and CKD Amsterdam, Berlin and London**

553 Literature on the association between PS and CKD prevalence among migrants is scant and absent in most
554 European populations. The lack of positive association between PS and CKD in our study is consistent with

1
2
3 558 recent studies conducted among African Americans^{31 33} and other populations^{32 60}. Specifically, a recent
4 559 study using data from the Jackson Heart Study, which comprised of extensive constructs of psychosocial
5 560 variables reported that greater life stressors were associated with lower prevalence of CKD at baseline³¹.
6
7 561 Several studies in other parts of the world have reported a positive relationship between higher prevalence
8
9 562 of stressors and CKD risk^{27 28}, although the study findings have been inconsistent. Whereas some did not
10
11 563 find any associations among African Americans³¹ others found associations in other populations. Even
12
13 564 among those who found some associations the directions differed²⁸. Reasons for the lack of association
14
15 565 observed in our study among migrants are not fully understood but may reflect the real world situation.
16
17 566 First, migrants from Ghana practice both nuclear and extended family support system as their peers living
18
19 567 in rural and urban, this practice may mitigate the impact of stressors such as unemployment, death of a love
20
21 568 one, discrimination, etc. They also belong to several religious organisations such as churches, which
22
23 569 provide similar support systems against stressors. Moreover, there are several associations of the various
24
25 570 ethnic groups (Akan, Ga and Ewe) providing such support when the need arises. These systems provide
26
27 571 both instrumental and/or emotional social support⁶¹. These assertions are supported by several studies.
28
29 572 Specifically, these studies have shown that social support positively affect health outcomes through
30
31 573 mechanisms such as increased patient compliance with therapies, decreased levels of depressive affect,
32
33 574 direct physiologic effects on the immune system and improved perception of quality of life^{58 59}. The lack
34
35 575 of association observed in this study may also be attributed to other mechanisms, which influence the
36
37 576 associations between PS and CKD. Another reason for the lack of association between PS and CKD in this
38
39 577 study could be the cross-sectional analysis of our study. The association between PS and CKD has been
40
41 578 shown to be cumulative and builds over substantial period of time⁶². To effectively evaluate this,
42
43 579 longitudinal study design is required. This suggests the needs for more longitudinal studies in future
44
45 580 research in assessing the associations between PS and CKD outcomes^{62 63}.

581

582

583 **Strength and limitation**

584

585 Our study is the first to use all four robust constructs of PS to determine association between PS and CKD.

586 This gave our study a more robust definition of PS compared to other similar studies. The use of all three

587 definitions of CKD per KDIGO guidelines also provided a broader definition of CKD and allowed

588 comparison between different geographical regions. The use of a homogenous population of Ghanaians and

589 standardized protocols and diagnostic criteria in this study also provided a novel opportunity to compare

590 Ghanaians living in rural and urban Ghana and their compatriots living in Europe. There are limitations to

591 our study. The effect of PS on CKD has been reported to be cumulative and takes a long period of time,

592 therefore the use of cross-sectional design prevented us from determining the longitudinal and cumulative

1
2
3 593 effect of repeated exposure to PS among the two populations. PS is captured and experienced in different
4 594 magnitude across different populations. We were unable to ascertain if PS as defined in this study was
5 595 adequately captured among Ghanaians living in rural and urban Ghana.
6
7

8 596

597 Conclusion

9 598

10 599 Generally, our study shows no associations between stress as indicated by four PS indicators and prevalence
11 600 of CKD. Consequently, there is the need to explore other factors that may be responsible for the observed
12 601 differences in the prevalence of CKD among Ghanaians living in rural and urban Ghana and their peers
13 602 living in Europe.
14

603 Acknowledgement

15
16
17
18
19 604 The authors are very grateful to the research assistants, interviewers and other staff of the five research
20 605 locations who took part in gathering the data and the Ghanaian volunteers in all the participating RODAM
21 606 sites. We gratefully acknowledge the advisory board members for their valuable support in shaping the
22 607 RODAM study methods and the Academic Medical Centre Biobank for their support in biobank
23 608 management and high-quality storage of collected samples.
24
25
26

27 609

28 610

611 Contributors

29
30
31 612 My co-authors have all contributed substantially to this manuscript and approve of this submission.
32 613 Research idea and study design: DNA, CA, KS, DA, EB, KM, JA; data acquisition and curation:
33 614 DNA, CA, EB, KM, data analysis/interpretation: DNA, CA, KS, DA, EB, KM, LS, JA, EOD,
34 615 KKG, FPM, MBS, ID, JS, SB; statistical analysis: DNA, CA, KS. DNA, CA, KS, DA, EB, KM,
35 616 LS, JA, EOD, KKG, FPM, MBS, ID, JS, SB; contributed important intellectual content during
36 617 manuscript drafting or revision and accepts accountability for the overall work by ensuring that
37 618 questions pertaining to the accuracy or integrity of any portion of the work are appropriately
38 619 investigated and resolved. DNA and CA takes responsibility that this study has been reported
39 620 honestly, accurately, and transparently; that no important aspects of the study have been omitted;
40 621 and that any discrepancies from the study as planned have been explained.
41
42
43
44

45 622

623 Funding

46 624

47 625 This work was supported by the European Commission under the Framework Programme (Grant Number:
48 626 278901). The funders had no role in study design, data collection and analysis, decision to publish, or
49
50
51
52
53
54
55
56
57
58
59

1
2
3 627 preparation of the manuscript. The Wellcome Trust supported Professor Smeeth's contribution, grant
4
5 628 number WT082178. Professor Joachim Spranger was supported by the DZHK (German Center for
6
7 629 cardiovascular research) and the Berlin Institute of Health (BIH).
8
9

10 **Competing interest:** I have communicated with all my co-authors and obtained their full
11 disclosures. My co-authors and I declare no conflicts of interest.
12
13

14 **Patient Consent:** None declared
15

16 634
17 **Ethics approval:** IRBs at each participating site.
18

19 **Data sharing statement:** Data are available from the RODAM research cohort, a third party. Dr.
20 Eric Beune affiliated with the RODAM research cohort and a co-author of this paper in accordance
21 with the RODAM requirements for collaboration. Dr. Beune is the Data Collection Coordinator of
22 RODAM and may be contacted with further questions (e.j.beune@amc.uva.nl). Additionally,
23 researchers interested in further collaboration with RODAM may see the following URL:
24 <http://www.rod-am.eu/>
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

References

1. Weisbord SD. Symptoms and their correlates in chronic kidney disease. *Adv Chronic Kidney Dis* 2007;14(4):319-27.
2. Correa-Rotter R, Naicker S, Katz IJ, et al. Demographic and epidemiologic transition in the developing world: role of albuminuria in the early diagnosis and prevention of renal and cardiovascular disease. *Kidney Int* 2004;66:S32-S37.
3. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet* 2012;380(9859):2095-128.
4. Katz IJ, Gerntholtz T, Naicker S. Africa and nephrology: the forgotten continent. *Nephron Clinical Practice* 2011;117(4):320-27.
5. Bruce MA, Beech BM, Sims M, et al. Social environmental stressors, psychological factors, and kidney disease. *J Investig Med* 2009;57(4):583-89.
6. Osafo C, Mate-Kole M, Affram K, et al. Prevalence of chronic kidney disease in hypertensive patients in Ghana. *Ren Fail* 2011;33(4):388-92.
7. Ojo A. Addressing the global burden of chronic kidney disease through clinical and translational research. *Trans Am Clin Climatol Assoc* 2014;125:229.
8. Norris K, Nissenson AR. Race, gender, and socioeconomic disparities in CKD in the United States. *J Am Soc Nephrol* 2008;19(7):1261-70.
9. Volkova N, McClellan W, Klein M, et al. Neighborhood poverty and racial differences in ESRD incidence. *J Am Soc Nephrol* 2008;19(2):356-64.
10. Shoham DA, Vupputuri S, Roux AVD, et al. Kidney disease in life-course socioeconomic context: the Atherosclerosis Risk in Communities (ARIC) Study. *Am J Kidney Dis* 2007;49(2):217-26.
11. Tarver-Carr ME, Powe NR, Eberhardt MS, et al. Excess risk of chronic kidney disease among African-American versus white subjects in the United States: a population-based study of potential explanatory factors. *J Am Soc Nephrol* 2002;13(9):2363-70.
12. Adjei DN, Stronks K, Adu D, et al. Chronic kidney disease burden among African migrants in three European countries and in urban and rural Ghana: the RODAM cross-sectional study. *Nephrology Dialysis Transplantation* 2018
13. Adjei DN, Stronks K, Adu D, et al. Relationship between educational and occupational levels, and Chronic Kidney Disease in a multi-ethnic sample-The HELIUS study. *PLoS One* 2017;12(11):e0186460.
14. Fremont A, Bird CE. Social and psychological factors, physiological processes, and physical health. 2000
15. Krantz DS, McCeney MK. Effects of psychological and social factors on organic disease: a critical assessment of research on coronary heart disease. *Annu Rev Psychol* 2002;53(1):341-69.
16. Cukor D, Fruchter Y, Ver Halen N, et al. A preliminary investigation of depression and kidney functioning in patients with chronic kidney disease. *Nephron Clinical practice* 2012;122(3-4):139-45.
17. Davidson K, Jonas BS, Dixon KE, et al. Do depression symptoms predict early hypertension incidence in young adults in the CARDIA study? *Arch Intern Med* 2000;160(10):1495-500.

- 1
2
3 708 18. Amerena J, Julius S. The role of the autonomic nervous system in hypertension. *Hypertens*
4 709 *Res* 1995;18(2):99-110.
- 5 710 19. Calhoun DA, Mutinga ML. Race, family history of hypertension, and sympathetic response to
6 711 cold pressor testing. *Blood Press* 1997;6(4):209-13.
- 7 712 20. Dibona GF. Neural control of the kidney: past, present, and future. *Hypertension*
8 713 2003;41(3):621-24.
- 9 714 21. Auchincloss AH, Diez Roux AV, Brown DG, et al. Association of insulin resistance with distance
10 715 to wealthy areas: the multi-ethnic study of atherosclerosis. *Am J Epidemiol*
11 716 2006;165(4):389-97.
- 12 717 22. Bruce MA, Sims M, Miller S, et al. One size fits all? Race, gender and body mass index among
13 718 US adults. *J Natl Med Assoc* 2007;99(10):1152.
- 14 719 23. McEwen BS. Protective and damaging effects of stress mediators. *N Engl J Med*
15 720 1998;338(3):171-79.
- 16 721 24. Cohen S, Herbert TB. Health psychology: Psychological factors and physical disease from the
17 722 perspective of human psychoneuroimmunology. *Annu Rev Psychol* 1996;47(1):113-42.
- 18 723 25. Barker D. Fetal origins of coronary heart disease. *Br Heart J* 1993;69(3):195.
- 19 724 26. Phillips DI, Jones A, Goulden PA. Birth weight, stress, and the metabolic syndrome in adult
20 725 life. *Ann N Y Acad Sci* 2006;1083(1):28-36.
- 21 726 27. Kim JW, Moon SJ, Kim HJ, et al. Relationship between Chronic Kidney Disease and Depression
22 727 in Elderly Koreans Using the 2013 Korea National Health and Nutrition Examination
23 728 Survey Data. *Korean journal of family medicine* 2017;38(3):156-62.
- 24 729 28. Loosman WL, Rottier MA, Honig A, et al. Association of depressive and anxiety symptoms
25 730 with adverse events in Dutch chronic kidney disease patients: a prospective cohort study.
26 731 *BMC Nephrol* 2015;16(1):155.
- 27 732 29. Novak M, Mucsi I, Mendelssohn D. Screening for depression: only one piece of the puzzle.
28 733 *Nephrology Dialysis Transplantation* 2013;28(6):1336-40.
- 29 734 30. McKercher CM, Venn AJ, Blizzard L, et al. Psychosocial factors in adults with chronic kidney
30 735 disease: characteristics of pilot participants in the Tasmanian Chronic Kidney Disease
31 736 study. *BMC Nephrol* 2013;14(1):83.
- 32 737 31. Lunyera J, Davenport CA, Bhavsar NA, et al. Nondepressive Psychosocial Factors and CKD
33 738 Outcomes in Black Americans. *Clin J Am Soc Nephrol* 2018:CJN. 06430617.
- 34 739 32. Annor FB, Masyn KE, Okosun IS, et al. Psychosocial stress and changes in estimated glomerular
35 740 filtration rate among adults with diabetes mellitus. *Kidney research and clinical practice*
36 741 2015;34(3):146-53.
- 37 742 33. Gholson GK, Mwendwa DT, Wright RS, et al. The Combined Influence of Psychological Factors
38 743 on Biomarkers of Renal Functioning in African Americans. *Ethn Dis* 2015;25(2):117.
- 39 744 34. Kaur M, Kaur A, Saggu A, et al. Comparative study on psychosocial stresses among urban and
40 745 rural geriatric population in selected areas of district Ludhiana (Punjab), 2006. *Nursing*
41 746 *and Midwifery Research* 2007;3(2)
- 42 747 35. Agyemang C, Beune E, Meeks K, et al. Rationale and cross-sectional study design of the
43 748 Research on Obesity and type 2 Diabetes among African Migrants: the RODAM study. *BMJ*
44 749 *open* 2015;4(3):e004877.
- 45 750 36. Agyemang C, Snijder MB, Adjei DN, et al. Ethnic Disparities in CKD in the Netherlands: The
46 751 Healthy Life in an Urban Setting (HELIUS) Study. *Am J Kidney Dis* 2016;67(3):391-99.

- 1
2
3 752 37. Peek ME, Nunez-Smith M, Drum M, et al. Adapting the everyday discrimination scale to
4 753 medical settings: reliability and validity testing in a sample of African American patients.
5 754 *Ethn Dis* 2011;21(4):502.
- 7 755 38. Pérez DJ, Fortuna L, Alegria M. Prevalence and correlates of everyday discrimination among
8 756 US Latinos. *J Community Psychol* 2008;36(4):421-33.
- 9 757 39. Ikram UZ, Snijder MB, Fassaert TJ, et al. The contribution of perceived ethnic discrimination
10 758 to the prevalence of depression. *The European Journal of Public Health* 2014;25(2):243-
12 759 48.
- 13 760 40. Rosengren A, Hawken S, Ôunpuu S, et al. Association of psychosocial risk factors with risk of
14 761 acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the
15 762 INTERHEART study): case-control study. *The Lancet* 2004;364(9438):953-62.
- 17 763 41. Rosmalen J, Bos E, De Jonge P. Validation of the Long-term Difficulties Inventory (LDI) and the
18 764 List of Threatening Experiences (LTE) as measures of stress in epidemiological population-
19 765 based cohort studies. *Psychol Med* 2012;42(12):2599-608.
- 20 766 42. Brugha T, Bebbington P, Tennant C, et al. The List of Threatening Experiences: a subset of 12
21 767 life event categories with considerable long-term contextual threat. *Psychol Med*
23 768 1985;15(1):189-94.
- 24 769 43. Kroenke K, Spitzer RL, Williams JB. The phq-9. *J Gen Intern Med* 2001;16(9):606-13.
- 25 770 44. Association AD. Standards of Medical Care in Diabetes—2014. *Diabetes Care* 2014; 37 (Suppl.
26 771 1): S14–S80. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 2014; 37
27 772 (Suppl. 1): S81–S90. *Diabetes Care* 2014;37(3):887-87.
- 29 773 45. Stevens LA, Schmid CH, Greene T, et al. Comparative performance of the CKD Epidemiology
30 774 Collaboration (CKD-EPI) and the Modification of Diet in Renal Disease (MDRD) Study
31 775 equations for estimating GFR levels above 60 mL/min/1.73 m². *Am J Kidney Dis*
32 776 2010;56(3):486-95.
- 34 777 46. Kellum JA, Lameire N, Aspelin P, et al. Kidney disease: improving global outcomes (KDIGO)
35 778 acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury.
36 779 *Kidney international supplements* 2012;2(1):1-138.
- 37 780 47. KDIGO G. Work Group. KDIGO clinical practice guideline for glomerulonephritis. *Kidney inter,*
38 781 *Suppl* 2012;2:139-274.
- 40 782 48. Rivera B, Casal B, Currais L. Length of stay and mental health of the immigrant population in
41 783 Spain: Evidence of the healthy immigrant effect. *Applied Economics* 2015;47(19):1972-82.
- 42 784 49. Collins AJ, Foley RN, Herzog C, et al. US Renal Data System 2010 Annual Data Report. *American*
43 785 *journal of kidney diseases: the official journal of the National Kidney Foundation*
44 786 2011;57(1 Suppl 1):A8, e1.
- 46 787 50. Fox CS, Larson MG, Leip EP, et al. Predictors of new-onset kidney disease in a community-
47 788 based population. *JAMA* 2004;291(7):844-50.
- 48 789 51. Banks J, Marmot M, Oldfield Z, et al. Disease and disadvantage in the United States and in
49 790 England. *JAMA* 2006;295(17):2037-45.
- 51 791 52. Levin A, Stevens L, McCullough PA. Cardiovascular disease and the kidney: Tracking a killer in
52 792 chronic kidney disease. *Postgrad Med* 2002;111(4):53-60.
- 53 793 53. Tsai Y-C, Chiu Y-W, Hung C-C, et al. Association of symptoms of depression with progression
54 794 of CKD. *Am J Kidney Dis* 2012;60(1):54-61.

- 1
2
3 795 54. Bruce MA, Griffith DM, Thorpe RJ. Stress and the kidney. *Adv Chronic Kidney Dis*
4 796 2015;22(1):46-53.
5
6 797 55. Brummett BH, Barefoot JC, Siegler IC, et al. Characteristics of socially isolated patients with
7 798 coronary artery disease who are at elevated risk for mortality. *Psychosom Med*
8 799 2001;63(2):267-72.
9
10 800 56. Eng PM, Rimm EB, Fitzmaurice G, et al. Social ties and change in social ties in relation to
11 801 subsequent total and cause-specific mortality and coronary heart disease incidence in
12 802 men. *Am J Epidemiol* 2002;155(8):700-09.
13 803 57. Psychosocial factors in patients with chronic kidney disease: The impact of social support on
14 804 end-stage renal disease. *Seminars in dialysis*; 2005. Wiley Online Library.
15 805 58. Cohen SD, Sharma T, Acquaviva K, et al. Social support and chronic kidney disease: an update.
16 806 *Adv Chronic Kidney Dis* 2007;14(4):335-44.
17
18 807 59. Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and
19 808 physiological processes: a review with emphasis on underlying mechanisms and
20 809 implications for health. *Psychol Bull* 1996;119(3):488.
21
22 810 60. Tsurugano S, Nakao M, Takeuchi T, et al. Job stress strengthens the link between metabolic
23 811 risk factors and renal dysfunction in adult men. *The Tohoku journal of experimental*
24 812 *medicine* 2012;226(2):101-08.
25 813 61. Tróccol BT. Desenvolvimento de escala para avaliação do suporte social em HIV/aids.
26 814 *Psicologia: Teoria e Pesquisa* 2006;22(3):317-26.
27
28 815 62. Schneiderman N, Ironson G, Siegel SD. Stress and health: psychological, behavioral, and
29 816 biological determinants. *Annu Rev Clin Psychol* 2005;1:607-28.
30 817 63. McKercher C, Sanderson K, Jose MD. Psychosocial factors in people with chronic kidney
31 818 disease prior to renal replacement therapy. *Nephrology* 2013;18(9):585-91.
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **840 Legend for figures**

4 841
5 842 **Figure 1:** Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have
6 843 not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving
7 844 Global Outcomes) guidelines.
8 845

9 846 **Figure 2:** Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not
10 847 experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global
11 848 Outcomes) guidelines.
12 849

13 850 **Figure 3:** Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have
14 851 not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO
15 852 (Kidney Disease: Improving Global Outcomes) guidelines.
16 853

17 854 **Figure 4:** Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have
18 855 depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes)
19 856 guidelines.
20 857

21 858

22 859

23 860

24 861

25 862

26 863

27 864

28 865

29 866

30 867

31 868

32 869

33 870

34 871

35 872

36 873

37 874

38 875

39 876

40 877

41 878

42 879

43 880

44 881

45 882

46 883

47 884

48 885

49 886

50 887

51 888

52

53

54

55

56

57

58

59

1
2
3 889 **Legend for Supplementary Tables**
4 890

5 891 **S1: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
6 892 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
7 893 **and those living in Europe.**
8 894

9 895 **S2: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
10 896 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
11 897 **and those living in Europe stratified by obesity status.**
12 898

13 899 **S3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
14 900 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
15 901 **and those living in Europe stratified by diabetes status.**
16 902

17 903 **S4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
18 904 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
19 905 **and those living in Europe stratified by hypertensive status.**
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

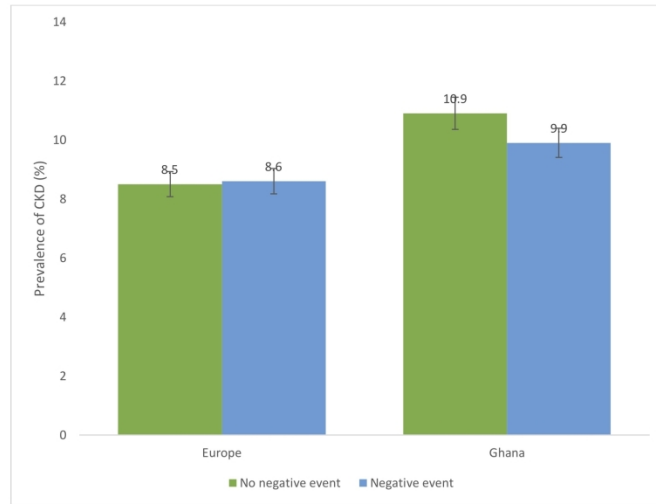


Figure 1: Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 1: Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

215x279mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

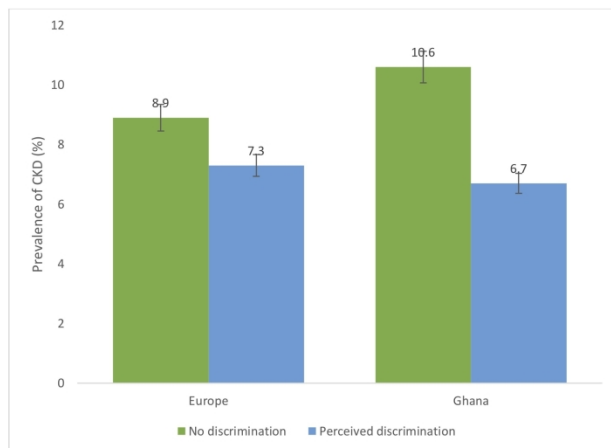


Figure 2: Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 2: Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

215x279mm (300 x 300 DPI)

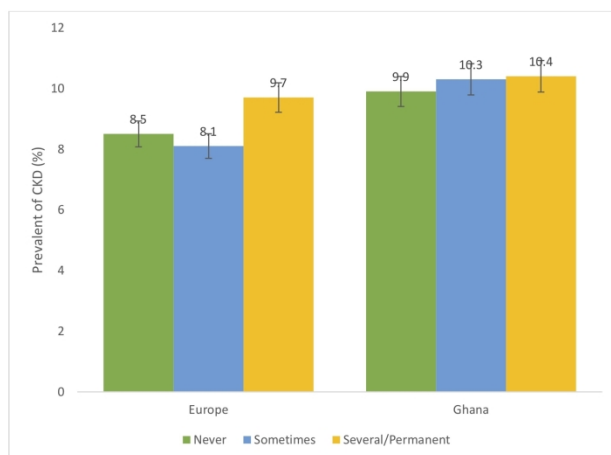


Figure 3: Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 3: Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

215x279mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

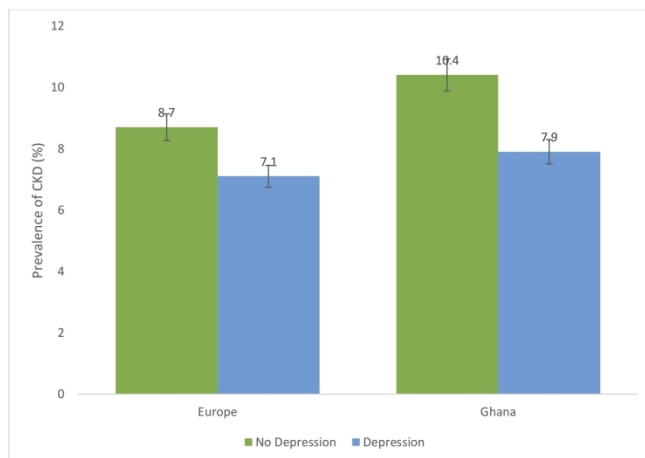


Figure 4: Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Figure 4: Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines

215x279mm (300 x 300 DPI)

Supplementary Tables

S1: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe

	Albuminuria (ACR ≥ 3 mg/mmol)		eGFR < 60 mL/min/1.73 m2		High to very high CKD risk (KDIGO, 2012)	
	OR (95% CI)		OR (95% CI)		OR (95% CI)	
	n (%)	Model 3	n (%)	Model 3	n cases (%)	Model 3
Negative events						
Europe						
No	1128 (8.2)	1.00 (Reference)	1106 (2.6)	1.00 (Reference)	1090 (8.5)	1.00 (Reference)
Yes	1615 (8.4)	0.95 (0.70-1.30)	1587 (2.5)	0.77 (0.44-1.37)	1557 (8.6)	0.92 (0.67-1.26)
Ghana						
No	732 (10.4)	1.00 (Reference)	736 (4.5)	1.00 (Reference)	732 (10.9)	1.00 (Reference)
Yes	1595 (9.2)	0.79 (0.58-1.07)	1601 (3.4)	0.69 (0.43-1.09)	1590 (9.9)	0.79 (0.58-1.06)
Discrimination						
Europe						
No	1899 (8.5)	1.00 (Reference)	1867 (2.6)	1.00 (Reference)	1832 (8.9)	1.00 (Reference)
Yes	810 (7.4)	0.87 (0.61-1.21)	791 (2.2)	0.87 (0.45-1.65)	782 (7.3)	0.79 (0.55-1.12)
Ghana						
No	2034 (10.0)	1.00 (Reference)	2047 (3.9)	1.00 (Reference)	2031 (10.6)	1.00 (Reference)
Yes	104 (7.7)	0.92 (0.43-1.98)	104 (1.9)	0.65 (0.15-2.79)	104 (6.7)	0.74 (0.33-1.66)
Stress at home/work						
Europe						
Never	1330 (8.2)	1.00 (Reference)	1305 (3.4)	1.00 (Reference)	1282 (8.5)	1.00 (Reference)
Some stress	1002 (7.9)	1.01 (0.72-1.41)	984 (1.4)	0.51 (0.25-1.04)	968 (8.1)	1.01 (0.72-1.42)
Several/Permanent stresses	397 (9.1)	1.00 (0.64-1.59)	390 (2.3)	0.91 (0.40-2.03)	383 (9.7)	1.15 (0.74-1.79)
Ghana						

Never	682 (10.3)	1.00 (Reference)	688 (3.3)	1.00 (Reference)	682 (9.9)	1.00 (Reference)
Some stress	1279 (9.5)	0.78 (0.56-1.09)	1279 (3.9)	1.14 (0.67-1.93)	1274 (10.3)	0.93 (0.67-1.29)
Several/Permanent stresses	365 (8.5)	0.70 (0.43-1.13)	369 (4.1)	1.32 (0.65-1.68)	365 (10.4)	0.97 (0.62-1.52)
Depressive symptoms						
Europe						
No	2505 (8.5)	1.00 (Reference)	2457 (2.7)	1.00 (Reference)	2416 (8.7)	1.00 (Reference)
Yes	206 (6.3)	0.65 (0.33-1.28)	202 (1.5)	0.94 (0.28-3.14)	199 (7.1)	0.78 (0.41-1.47)
Ghana						
No	2212 (9.9)	1.00 (Reference)	2222 (3.8)	1.00 (Reference)	2207 (10.4)	1.00 (Reference)
Yes	114 (5.3)	0.41 (0.16-1.04)	114 (2.6)	0.58 (0.17-1.95)	114 (7.9)	0.62 (0.28-1.31)

Model 3, adjusted for age, sex educational level, hypertension, diabetes, hypercholesterolemia, BMI, physical activity and smoking; Abbreviations: CI, confidence interval; ACR, albumin creatinine ratio; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

S2: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by obesity status

	Albuminuria (ACR ≥ 3 mg/mmol)			eGFR < 60 mL/min/1.73 m2			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe/Not obese									
No	736 (7.4)	1.00 (Reference)	1.00 (Reference)	729 (2.5)	1.00 (Reference)	1.00 (Reference)	719 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	1003 (7.7)	0.98 (0.67-1.40)	0.99 (0.69-1.43)	992 (2.0)	0.77 (0.40-1.48)	0.71 (0.36-1.42)	971 (7.9)	0.91 (0.64-1.29)	0.89 (0.62-1.29)
Europe/Obese									
No	390 (9.2)	1.00 (Reference)	1.00 (Reference)	375 (2.9)	1.00 (Reference)	1.00 (Reference)	369 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	607 (9.6)	1.05 (0.67-1.63)	1.14 (0.72-1.82)	590 (3.2)	0.97 (0.44-2.11)	1.01 (0.44-2.26)	581 (9.6)	1.15 (0.73-1.82)	1.15 (0.71-1.85)
Ghana/Not obese									
No	588 (9.5)	1.00 (Reference)	1.00 (Reference)	592 (4.7)	1.00 (Reference)	1.00 (Reference)	588 (10.0)	1.00 (Reference)	1.00 (Reference)
Yes	1324 (8.5)	0.86 (0.61-1.21)	0.83 (0.59-1.17)	1331 (3.4)	0.64 (0.39-1.05)	0.65 (0.39-1.83)	1321 (9.0)	0.86 (0.61-1.20)	0.84 (0.60-1.18)
Ghana/Obese									
No	144 (13.9)	1.00 (Reference)	1.00 (Reference)	144 (3.5)	1.00 (Reference)	1.00 (Reference)	144 (14.6)	1.00 (Reference)	1.00 (Reference)
Yes	268 (13.1)	0.91 (0.50-1.64)	0.91 (0.49-1.65)	267 (3.8)	1.04 (0.34-3.16)	1.09 (0.35-3.37)	266 (14.3)	0.94 (0.52-1.68)	0.94 (0.52-1.67)
Discrimination									
Europe/Not obese									
No	1186 (8.4)	1.00 (Reference)	1.00 (Reference)	1172 (2.4)	1.00 (Reference)	1.00 (Reference)	1150 (9.4)	1.00 (Reference)	1.00 (Reference)
Yes	538 (5.9)	0.69 (0.46-1.05)	0.71 (0.46-1.11)	532 (1.5)	0.62 (0.28-1.37)	0.57 (0.24-1.34)	525 (5.9)	0.63 (0.42-0.96)	0.63 (0.41-0.97)
Europe/Obese									
No	709 (8.7)	1.00 (Reference)	1.00 (Reference)	691 (3.0)	1.00 (Reference)	1.00 (Reference)	678 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	269 (10.0)	1.14 (0.71-1.85)	1.29 (0.78-2.12)	256 (3.5)	1.15 (0.50-2.63)	1.27 (0.54-2.99)	254 (9.8)	1.13 (0.69-1.86)	1.22 (0.73-2.13)
Ghana/Not obese									
No	1648 (9.1)	1.00 (Reference)	1.00 (Reference)	1661 (3.9)	1.00 (Reference)	1.00 (Reference)	1646 (9.6)	1.00 (Reference)	1.00 (Reference)
Yes	81 (8.6)	1.06 (0.48-2.38)	1.04 (0.47-2.32)	81 (2.5)	1.04 (0.48-2.32)	0.86 (0.20-3.69)	81 (7.4)	0.90 (0.38-2.12)	0.89 (0.38-2.11)
Ghana/Obese									

1										
2										
3	No	383 (13.8)	1.00 (Reference)	1.00 (Reference)	383 (3.7)	1.00 (Reference)	1.00 (Reference)	382 (14.9)	1.00 (Reference)	1.00 (Reference)
4	Yes	23 (4.4)	0.31 (0.04-2.36)	0.40 (0.05-3.11)	23 (0.0)	**** (***_***)	**** (***_***)	23 (4.4)	0.29 (0.04-2.22)	0.34 (0.04-2.66)
5										
6	Stress at									
7	home/work									
8	Europe/Not obese									
9	Never	855 (7.4)	1.00 (Reference)	1.00 (Reference)	847 (3.4)	1.00 (Reference)	1.00 (Reference)	831 (8.2)	1.00 (Reference)	1.00 (Reference)
10	Some stress	629 (8.3)	1.16 (0.79-1.70)	1.20 (0.81-1.79)	627 (1.4)	0.52 (0.24-1.12)	0.47 (0.21-1.07)	615 (7.9)	0.98 (0.66-1.43)	0.98 (0.65-1.46)
11	Several/Permanent stresses	247 (6.9)	0.93 (0.53-1.62)	1.15 (0.77-1.72)	239 (2.3)	0.45 (0.13-1.52)	0.49 (0.15-1.67)	236 (9.1)	0.97 (0.57-1.65)	1.04 (0.61-1.78)
12										
13	Europe/Obese									
14	Never	472 (9.8)	1.00 (Reference)	1.00 (Reference)	455 (3.9)	1.00 (Reference)	1.00 (Reference)	448 (10.3)	1.00 (Reference)	1.00 (Reference)
15	Some stress	372 (7.5)	0.72 (0.44-1.18)	0.79 (0.47-1.32)	356 (1.4)	0.41 (0.15-1.16)	0.43 (0.15-1.21)	352 (9.5)	0.94 (0.57-1.53)	1.05 (0.62-1.76)
16	Several/Permanent stresses	147 (12.2)	1.32 (0.74-2.38)	1.31 (0.72-2.42)	148 (4.1)	1.05 (0.40-2.79)	1.09 (0.40-2.91)	144 (8.5)	1.36 (0.74-2.49)	1.41 (0.75-2.64)
17										
18	Ghana/Not obese									
19	Never	537 (9.7)	1.00 (Reference)	1.00 (Reference)	542 (3.1)	1.00 (Reference)	1.00 (Reference)	537 (8.9)	1.00 (Reference)	1.00 (Reference)
20	Some stress	1055 (8.3)	0.79 (0.56-1.15)	0.74 (0.52-1.07)	1057 (3.9)	1.16 (0.65-2.09)	1.21 (0.67-2.18)	1052 (9.0)	0.92 (0.64-1.35)	0.90 (0.62-1.32)
21	Several/permanent stresses	319 (8.5)	0.81 (0.49-1.32)	0.73 (0.44-1.20)	323 (4.3)	1.34 (0.64-2.83)	1.43 (0.67-3.04)	319 (10.7)	1.12 (0.69-1.79)	1.09 (0.68-1.76)
22										
23	Ghana/Obese									
24	Never	145 (12.4)	1.00 (Reference)	1.00 (Reference)	146 (4.1)	1.00 (Reference)	1.00 (Reference)	145 (13.8)	1.00 (Reference)	1.00 (Reference)
25	Some stress	221 (14.9)	1.21 (0.64-2.26)	1.05 (0.55-1.99)	219 (3.7)	0.74 (0.25-2.22)	0.83 (0.26-2.06)	219 (15.9)	1.13 (0.62-2.07)	1.02 (0.55-1.89)
26	Several/Permanent stresses	46 (8.7)	0.64 (0.20-2.01)	0.52 (0.16-1.65)	46 (2.2)	0.41 (0.05-3.61)	0.45 (0.05-4.01)	46 (8.8)	0.55 (0.17-1.71)	0.47 (0.14-1.50)
27										
28	Depressive symptoms									
29	Europe/Not obese									
30	No	1601 (7.9)	1.00 (Reference)	1.00 (Reference)	1586 (2.2)	1.00 (Reference)	1.00 (Reference)	1558 (8.3)	1.00 (Reference)	1.00 (Reference)
31	Yes	121 (4.9)	0.59 (0.25-1.36)	0.65 (0.27-1.48)	117 (1.7)	0.79 (0.18-2.35)	0.86 (0.21-3.80)	115 (5.22)	0.58 (0.25-1.35)	0.64 (0.27-1.49)
32										
33	Europe/Obese									
34	No	899 (9.7)	1.00 (Reference)	1.00 (Reference)	866 (3.4)	1.00 (Reference)	1.00 (Reference)	853 (9.4)	1.00 (Reference)	1.00 (Reference)
35	Yes	83 (7.2)	0.71 (0.29-1.67)	0.72 (0.30-1.74)	83 (1.2)	0.46 (0.06-3.52)	0.46 (0.06-3.57)	82 (8.5)	0.89 (0.40-2.01)	0.90 (0.40-2.04)
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Ghana/Not obese

No	1811 (8.9)	1.00 (Reference)	1.00 (Reference)	1822 (3.9)	1.00 (Reference)	1.00 (Reference)	1808 (9.4)	1.00 (Reference)	1.00 (Reference)
Yes	100 (6.0)	0.57 (0.24-1.33)	0.56 (0.24-1.32)	100 (2.0)	0.38 (0.09-1.63)	0.38 (0.09-1.63)	100 (8.0)	0.69 (0.32-1.46)	0.69 (0.32-1.47)

Ghana/Obese

No	398 (13.8)	1.00 (Reference)	1.00 (Reference)	397 (3.5)	1.00 (Reference)	1.00 (Reference)	396 (14.7)	1.00 (Reference)	1.00 (Reference)
Yes	14 (0.0)	*** (****_****)	*** (****_****)	14 (7.1)	1.76 (0.21-14.89)	2.14 (0.25-8.78)	14 (7.1)	0.42 (0.05-3.32)	0.38 (0.05-3.07)

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

For peer review only

S3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by diabetes status

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)	Model 2	n (%)	OR (95% CI)	Model 2	n cases (%)	OR (95% CI)	Model 2
Negative events									
Europe/No diabetes									
No	986 (8.0)	1.00 (Reference)	1.00 (Reference)	971 (2.1)	1.00 (Reference)	1.00 (Reference)	957 (7.9)	1.00 (Reference)	1.00 (Reference)
Yes	1359 (7.7)	0.95 (0.70-1.29)	0.97 (0.71-1.34)	1340 (2.0)	0.90 (0.50-1.63)	0.90 (0.48-1.68)	1315 (8.1)	1.01 (0.75-1.37)	0.99 (0.72-1.36)
Europe/Diabetes									
No	142 (9.9)	1.00 (Reference)	1.00 (Reference)	135 (6.7)	1.00 (Reference)	1.00 (Reference)	133 (12.8)	1.00 (Reference)	1.00 (Reference)
Yes	256 (12.5)	1.28 (0.66-2.50)	1.41 (0.71-2.82)	247 (4.9)	0.75 (0.29-1.89)	10.68 (0.27-1.77)	242 (11.2)	0.87 (0.46-1.69)	0.96 (0.49-1.88)
Ghana/No diabetes									
No	683 (9.1)	1.00 (Reference)	1.00 (Reference)	687 (4.1)	1.00 (Reference)	1.00 (Reference)	683 (9.8)	1.00 (Reference)	1.00 (Reference)
Yes	1447 (7.7)	0.84 (0.60-1.16)	0.82 (0.59-1.14)	1451 (3.1)	0.69 (0.42-1.13)	0.69 (0.42-1.13)	1442 (8.3)	0.82 (0.59-1.12)	0.80 (0.58-1.10)
Ghana/Diabetes									
No	49 (28.3)	1.00 (Reference)	1.00 (Reference)	49 (10.2)	1.00 (Reference)	1.00 (Reference)	49 (26.4)	1.00 (Reference)	1.00 (Reference)
Yes	148 (24.3)	0.78 (0.37-1.61)	0.72 (0.34-1.52)	150 (7.3)	0.55 (0.16-1.81)	0.57 (0.17-1.88)	148 (26.4)	0.93 (0.45-1.97)	0.90 (0.43-1.92)
Discrimination									
Europe/No diabetes									
No	1629 (7.9)	1.00 (Reference)	1.00 (Reference)	1609 (2.2)	1.00 (Reference)	1.00 (Reference)	1580 (8.3)	1.00 (Reference)	1.00 (Reference)
Yes	684 (6.7)	0.85 (0.60-1.21)	0.89 (0.62-1.28)	669 (1.5)	0.68 (0.33-1.40)	0.69 (0.32-1.47)	661 (7.0)	0.84 (0.59-1.20)	0.86 (0.59-1.25)
Europe/Diabetes									
No	270 (11.9)	1.00 (Reference)	1.00 (Reference)	258 (5.4)	1.00 (Reference)	1.00 (Reference)	252 (13.1)	1.00 (Reference)	1.00 (Reference)
Yes	126 (11.1)	0.87 (0.44-1.71)	0.89 (0.45-1.76)	122 (5.7)	1.29 (0.48-3.45)	1.25 (0.46-3.37)	121 (9.1)	0.68 (0.32-1.40)	0.69 (0.33-1.42)
Ghana/No diabetes									
No	1854 (8.4)	1.00 (Reference)	1.00 (Reference)	1865 (3.5)	1.00 (Reference)	1.00 (Reference)	1851 (9.0)	1.00 (Reference)	1.00 (Reference)
Yes	99 (8.1)	1.03 (0.49-2.17)	1.04 (0.49-2.19)	99 (2.0)	0.79 (0.19-3.33)	0.78 (0.18-3.29)	99 (7.1)	0.87 (0.39-1.93)	0.88 (0.39-1.95)

1										
2										
3	Ghana/Diabetes									
4	No	180 (26.7)	1.00 (Reference)	1.00 (Reference)	182 (7.7)	1.00 (Reference)	1.00 (Reference)	180 (27.2)	1.00 (Reference)	1.00 (Reference)
5	Yes	5 (0.0)	**** (***_***)	0.40 (0.05-3.11)	5 (0.0)	**** (***_***)	**** (***_***)	5 (0.0)	**** (***_***)	**** (***_***)
6										
7	Stress at home/work									
8										
9	Europe/No diabetes									
10	Never	1137 (7.9)	1.00 (Reference)	1.00 (Reference)	1127 (2.3)	1.00 (Reference)	1.00 (Reference)	1102 (8.0)	1.00 (Reference)	1.00 (Reference)
11	Some stress	860 (7.2)	0.90 (0.65-1.27)	0.96 (0.68-1.36)	850 (1.2)	0.49 (0.24-1.02)	0.49 (0.22-1.07)	835 (7.4)	0.94 (0.67-1.31)	0.99 (0.69-1.41)
12	Several/Permanent stresses	335 (8.4)	1.04 (0.67-1.62)	1.07 (0.68-1.70)	327 (2.1)	0.84 (0.36-1.95)	0.92 (0.39-2.17)	322 (9.6)	1.20 (0.77-1.85)	1.28 (0.82-1.99)
13										
14	Europe/Diabetes									
15	Never	193 (9.8)	1.00 (Reference)	1.00 (Reference)	184 (8.2)	1.00 (Reference)	1.00 (Reference)	180 (11.7)	1.00 (Reference)	1.00 (Reference)
16	Some stress	142 (12.7)	1.22 (0.61-2.45)	1.38 (0.67-2.81)	134 (3.0)	0.43 (0.13-1.39)	0.40 (0.12-1.29)	133 (12.0)	1.04 (0.52-2.09)	1.13 (0.56-2.32)
17	Several/Permanent stresses	62 (12.9)	1.31 (0.54-3.16)	1.38 (0.56-3.41)	63 (3.2)	0.49 (0.10-2.29)	0.46 (0.10-2.23)	61 (9.8)	0.82 (0.31-2.13)	0.89 (0.34-2.35)
18										
19	Ghana/No diabetes									
20	Never	628 (7.8)	1.00 (Reference)	1.00 (Reference)	634 (2.7)	1.00 (Reference)	1.00 (Reference)	628 (7.6)	1.00 (Reference)	1.00 (Reference)
21	Some stress	1163 (8.6)	1.06 (0.74-1.51)	0.97 (0.67-1.39)	1163 (3.7)	1.27 (0.71-2.27)	1.32 (0.74-2.34)	1158 (9.3)	1.15 (0.80-1.65)	1.10 (0.77-1.58)
22	Several/permanent stresses	339 (7.4)	0.88 (0.53-1.46)	0.76 (0.46-1.27)	341 (3.5)	1.24 (0.58-2.67)	1.35 (0.62-2.95)	339 (8.9)	1.07 (0.66-1.73)	1.00 (0.61-1.64)
23										
24	Ghana/Diabetes									
25	Never	54 (38.9)	1.00 (Reference)	1.00 (Reference)	54 (11.1)	1.00 (Reference)	1.00 (Reference)	54 (37.0)	1.00 (Reference)	1.00 (Reference)
26	Some stress	116 (18.9)	0.37 (0.37-0.77)	0.35 (0.17-0.75)	116 (6.0)	0.47 (0.14-1.60)	0.45 (0.12-1.55)	116 (19.8)	0.43 (0.21-0.89)	0.40 (0.19-0.86)
27	Several/Permanent stresses	26 (25.0)	0.44 (0.44-1.29)	0.39 (0.13-1.19)	28 (10.7)	0.65 (0.13-3.21)	0.62 (0.12-3.23)	26 (30.8)	0.69 (0.25-1.93)	0.64 (0.22-1.87)
28										
29	Depressive symptoms									
30										
31	Europe/No diabetes									
32	No	2154 (8.0)	1.00 (Reference)	1.00 (Reference)	2122 (2.1)	1.00 (Reference)	1.00 (Reference)	2087 (8.1)	1.00 (Reference)	1.00 (Reference)
33	Yes	167 (5.4)	0.63 (0.32-1.25)	0.69 (0.34-1.38)	163 (2.0)	0.65 (0.15-2.72)	0.72 (0.17-3.04)	161 (6.8)	0.58 (0.25-1.35)	0.86 (0.46-1.64)
34										
35	Europe/Diabetes									
36	No									
37	Yes									
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										

1										
2										
3	No	351 (12.0)	1.00 (Reference)	1.00 (Reference)	335 (35.9)	1.00 (Reference)	1.00 (Reference)	329 (12.5)	1.00 (Reference)	1.00 (Reference)
4	Yes	39 (10.3)	0.79 (0.26-1.35)	0.73 (0.24-2.19)	39 (2.6)	0.49 (0.06-3.97)	0.49 (0.06-3.99)	38 (7.9)	0.89 (0.40-2.01)	0.60 (0.17-2.08)
5	Ghana/No									
6	diabetes									
7	No	2027 (8.3)	1.00 (Reference)	1.00 (Reference)	2035 (3.4)	1.00 (Reference)	1.00 (Reference)	2022 (8.8)	1.00 (Reference)	1.00 (Reference)
8	Yes	102 (4.9)	0.50 (0.20-1.25)	0.48 (0.19-1.19)	102 (2.9)	0.64 (0.19-2.13)	0.67 (0.20-2.21)	102 (7.8)	0.69 (0.32-1.46)	0.71 (0.34-1.51)
9	Ghana/Diabetes									
10	No	185 (26.5)	1.00 (Reference)	1.00 (Reference)	187 (8.7)	1.00 (Reference)	1.00 (Reference)	185 (27.6)	1.00 (Reference)	1.00 (Reference)
11	Yes	12 (8.3)	0.27 (0.03-2.13)	0.25 (0.03-2.01)	12 (0.0)	*** (***-***)	*** (***-***)	12 (8.3)	0.42 (0.05-3.32)	0.27 (0.03-2.19)
12										
13										
14										
15										

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

S4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by hypertensive status

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe/No hypertension									
No	568 (6.9)	1.00 (Reference)	1.00 (Reference)	562 (1.3)	1.00 (Reference)	1.00 (Reference)	551 (7.1)	1.00 (Reference)	1.00 (Reference)
Yes	743 (5.0)	0.72 (0.45-1.15)	0.78 (0.48-1.27)	740 (0.8)	0.59 (0.19-1.77)	0.60 (0.20-1.83)	724 (5.1)	0.71 (0.44-1.13)	0.75 (0.46-1.22)
Europe/Hypertension									
No	560 (9.6)	1.00 (Reference)	1.00 (Reference)	544 (4.0)	1.00 (Reference)	1.00 (Reference)	539 (10.0)	1.00 (Reference)	1.00 (Reference)
Yes	872 (11.4)	1.22 (0.86-1.73)	1.20 (0.83-1.73)	847 (3.9)	0.95 (0.54-1.67)	0.89 (0.49-1.62)	833 (11.6)	1.19 (0.83-1.69)	1.13 (0.78-1.62)
Ghana/No Hypertension									
No	540 (6.3)	1.00 (Reference)	1.00 (Reference)	543 (2.2)	1.00 (Reference)	1.00 (Reference)	540 (6.9)	1.00 (Reference)	1.00 (Reference)
Yes	1118 (5.6)	0.88 (0.57-1.36)	0.84 (0.54-1.31)	1124 (1.9)	0.82 (0.39-1.69)	0.86 (0.41-1.79)	1115 (6.4)	0.93 (0.61-1.40)	0.90 (0.59-1.36)
Ghana/Hypertension									
No	192 (21.9)	1.00 (Reference)	1.00 (Reference)	193 (10.9)	1.00 (Reference)	1.00 (Reference)	192 (22.4)	1.00 (Reference)	1.00 (Reference)
Yes	476 (18.1)	0.78 (0.52-1.18)	0.79 (0.52-1.20)	476 (6.9)	0.58 (0.32-1.04)	0.58 (0.33-1.05)	474 (18.4)	0.77 (0.50-1.16)	0.76 (0.51-1.16)
Discrimination									
Europe/No hypertension									
No	916 (6.3)	1.00 (Reference)	1.00 (Reference)	907 (0.8)	1.00 (Reference)	1.00 (Reference)	885 (6.8)	1.00 (Reference)	1.00 (Reference)
Yes	379 (3.7)	0.60 (0.33-1.09)	0.65 (0.36-1.21)	378 (1.1)	1.35 (0.39-4.74)	1.37 (0.38-4.89)	374 (3.2)	0.47 (0.25-0.89)	0.51 (0.27-0.97)
Europe/Hypertension									
No	983 (10.5)	1.00 (Reference)	1.00 (Reference)	960 (4.4)	1.00 (Reference)	1.00 (Reference)	947 (10.9)	1.00 (Reference)	1.00 (Reference)
Yes	431 (10.7)	1.03 (0.71-1.49)	1.05 (0.72-1.54)	413 (3.2)	0.73 (0.38-1.39)	0.75 (0.38-1.48)	408 (11.0)	1.03 (0.71-1.49)	1.04 (0.71-1.53)
Ghana/No hypertension									
No	1427 (5.7)	1.00 (Reference)	1.00 (Reference)	1437 (2.2)	1.00 (Reference)	1.00 (Reference)	1424 (6.5)	1.00 (Reference)	1.00 (Reference)

1										
2										
3	Yes	81 (7.4)	1.30 (0.55-3.09)	1.30 (0.55-3.10)	81 (0.0)	**** (***_***)	**** (***_***)	81 (7.4)	1.21 (0.51-2.88)	1.22 (0.51-2.89)
4	Ghana/Hyperten									
5	sion									
6	No	606 (20.3)	1.00 (Reference)	1.00 (Reference)	609 (7.9)	1.00 (Reference)	1.00 (Reference)	606 (20.3)	1.00 (Reference)	1.00 (Reference)
7	Yes	23 (8.7)	0.38 (0.09-1.68)	0.40 (0.09-1.74)	23 (8.7)	1.27 (0.28-5.70)	1.20 (0.26-5.44)	23 (4.4)	0.19 (0.03-1.44)	0.19 (0.03-1.45)
8										
9	Stress at									
10	home/work									
11	Europe/No									
12	hypertension									
13	Never	644 (6.1)	1.00 (Reference)	1.00 (Reference)	640 (1.3)	1.00 (Reference)	1.00 (Reference)	625 (5.8)	1.00 (Reference)	1.00 (Reference)
14	Some stress	468 (4.5)	0.74 (0.43-1.27)	0.81 (0.46-1.43)	464 (0.4)	0.37 (0.07-1.74)	0.41 (0.09-2.01)	457 (4.8)	0.84 (0.49-1.45)	0.91 (0.52-1.60)
15	Several/Permanent	192 (6.8)	1.07 (0.56-2.05)	1.19 (0.61-2.29)	191 (1.6)	1.49 (0.38-5.78)	1.52 (0.39-5.98)	186 (8.1)	1.38 (0.74-2.60)	1.49 (0.79-2.84)
16	stresses									
17	Europe/Hyperten									
18	sion									
19	Never	686 (10.2)	1.00 (Reference)	1.00 (Reference)	665 (5.4)	1.00 (Reference)	1.00 (Reference)	657 (11.1)	1.00 (Reference)	1.00 (Reference)
20	Some stress	534 (11.1)	1.03 (0.71-1.49)	1.05 (0.72-1.54)	520 (2.3)	0.49 (0.25-0.96)	0.47 (0.23-0.95)	511 (10.9)	0.97 (0.67-1.41)	0.99 (0.67-0.47)
21	Several/Permanent	205 (11.2)	1.11 (0.67-1.82)	1.12 (0.67-1.87)	199 (3.0)	0.56 (0.23-1.37)	0.58 (0.24-1.43)	197 (11.2)	0.99 (0.59-1.64)	1.03 (0.61-1.74)
22	stresses									
23	Ghana/No									
24	hypertension									
25	Never	495 (5.5)	1.00 (Reference)	1.00 (Reference)	498 (1.4)	1.00 (Reference)	1.00 (Reference)	495 (5.9)	1.00 (Reference)	1.00 (Reference)
26	Some stress	899 (5.9)	1.07 (0.66-1.73)	0.99 (0.61-1.60)	901 (2.2)	1.30 (0.54-3.15)	1.39 (0.57-3.37)	896 (6.5)	1.04 (0.65-1.65)	1.00 (0.63-1.59)
27	Several/permanent	263 (5.7)	1.01 (0.53-1.95)	0.89 (0.46-1.72)	267 (2.6)	1.69 (0.58-5.01)	1.89 (0.63-5.65)	263 (7.6)	1.21 (0.67-2.20)	1.15 (0.63-2.11)
28	stresses									
29	Ghana/Hyperten									
30	sion									
31	Never	187 (22.9)	1.00 (Reference)	1.00 (Reference)	190 (8.4)	1.00 (Reference)	1.00 (Reference)	187 (20.9)	1.00 (Reference)	1.00 (Reference)
32	Some stress	379 (18.2)	0.74 (0.48-1.14)	0.68 (0.43-1.05)	377 (7.9)	0.95 (0.50-1.80)	0.99 (0.51-1.91)	377 (19.4)	0.90 (0.58-1.40)	0.87 (0.55-1.36)
33	Several/Permanent	102 (15.7)	0.62 (0.33-1.17)	0.54 (0.28-1.04)	102 (7.8)	0.92 (0.37-2.26)	0.97 (0.39-2.43)	102 (17.7)	0.79 (0.42-1.49)	0.76 (0.40-1.43)
34	stresses									
35										
36	Depressive									
37	symptoms									
38	Europe/No									
39	hypertension									
40										
41										
42										
43										
44										
45										
46										
47										

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

No	1195 (5.9)	1.00 (Reference)	1.00 (Reference)	1187 (1.1)	1.00 (Reference)	1.00 (Reference)	1162 (6.0)	1.00 (Reference)	1.00 (Reference)	
Yes	101 (3.9)	0.59 (0.21-1.65)	0.64 (0.23-1.82)	99 (1.0)	1.18 (0.15-2.72)	1.27 (0.16-10.17)	98 (5.1)	0.77 (0.30-1.97)	0.84 (0.33-2.17)	
Europe/Hypertension										
No	1310(10.9)	1.00 (Reference)	1.00 (Reference)	1270 (4.1)	1.00 (Reference)	1.00 (Reference)	1254 (11.2)	1.00 (Reference)	1.00 (Reference)	
Yes	105 (8.6)	0.76 (0.37-1.53)	0.75 (0.37-1.55)	103 (1.9)	0.52 (0.12-2.18)	0.56 (0.13-2.38)	101 (8.9)	0.77 (0.38-1.58)	0.80 (0.39-1.63)	
Ghana/No hypertension										
No	1575 (5.9)	1.00 (Reference)	1.00 (Reference)	1584 (2.1)	1.00 (Reference)	1.00 (Reference)	1572 (6.7)	1.00 (Reference)	1.00 (Reference)	
Yes	82 (2.4)	0.36 (0.09-1.51)	0.35 (0.08-1.44)	82 (1.2)	0.39 (0.059-2.95)	0.39 (0.05-2.97)	82 (3.7)	0.44 (0.13-1.42)	0.43 (0.13-1.40)	
Ghana/Hypertension										
No	636 (19.5)	1.00 (Reference)	1.00 (Reference)	637 (8.2)	1.00 (Reference)	1.00 (Reference)	634 (19.6)	1.00 (Reference)	1.00 (Reference)	
Yes	32 (12.5)	0.59 (0.20-1.72)	0.59 (0.20-1.74)	32 (6.3)	0.74 (0.17-3.25)	0.76 (0.17-3.33)	32 (18.8)	0.94 (0.037-2.37)	0.94 (0.38-2.37)	

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1 lines 1-3	We have included a commonly used term in the title and abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3 lines 87-116	Our study shows no convincing evidence for associations between stress as indicated by four PS constructs and prevalence of CKD. Further studies aimed at identifying potential factors driving the high prevalence of CKD among these populations are needed.
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5 lines 180-226	The theoretical and scientific background as well as the rationale for conducting the study have been provided in the introduction section.
Objectives	3	State specific objectives, including any pre specified hypotheses	5 lines 222-226	We examined the association between PS and CKD prevalence among rural and urban Ghanaians and their migrants living in three European cities. We also

assessed if the influence of PS on CKD is partially mediated by primary risk factors (hypertension and diabetes) of CKD.

Methods

Study design	4	Present key elements of study design early in the paper	-6-7 lines 232-264	Details given in the methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7 lines 232-264	Rural or urban Ghana and three (Amsterdam, Berlin, London) European cities (migrants)
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	Pg. 7 lines 254-264	A multi-centred cross sectional baseline data from the Research on Obesity and Diabetes among African Migrants (RODAM) study. A random sample of 5,659 adults (Europe, 3167, rural, 1,043, Urban Ghana, 1,449, Ghana) aged 25 to 70 years.
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pg. 7-10 lines 266-357	The main outcomes have been clearly defined.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pg. 7-10 lines 266-357	We defined each variable of interest in the methods

				accordingly
Bias	9	Describe any efforts to address potential sources of bias	Pg. 9 lines 315-331	Potential sources of bias have been reported in the methods sections.
Study size	10	Explain how the study size was arrived at	Pg. 7 lines 259-264	Given in the methods section and we have also referred to the RODAM study methods paper

Continued on next page

For peer review only

1					
2	Quantitative	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which	Pg. 10-11	Please see methods
3	variables		groupings were chosen and why	lines 368-	
4				388	
5					
6	Statistical	12	(a) Describe all statistical methods, including those used to control for confounding	Pg. 10-11	Please see methods
7	methods			lines 367-	
8				387	
9					
10			(b) Describe any methods used to examine subgroups and interactions	Pg. 10-11	Please see methods
11				lines 367-	
12				387	
13					
14			(c) Explain how missing data were addressed	Pg. 7 lines	
15				259-264	
16			(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	NA	We have reported non-response
17			<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed		across sites
18			<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling		
19			strategy		
20					
21			(e) Describe any sensitivity analyses	NA	
22					
23	Results				
24	Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined	Pg. 7 lines	Non-response analysis was done to
25			for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	254-264	shed light on the differential
26					response rates across sites
27			(b) Give reasons for non-participation at each stage	Pg. 7 lines	
28				259-264	
29					
30			(c) Consider use of a flow diagram	Pg. 6 lines	We have also referred to RODAM
31				232-234	methods paper
32	Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on	Pg. 7 lines	We have also referred to RODAM
33			exposures and potential confounders	269-357	methods paper
34			(b) Indicate number of participants with missing data for each variable of interest	Pg. 7 lines	We have also referred to RODAM
35				260-264	methods paper
36					
37			(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	NA	
38	Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	NA	
39			<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	NA	
40					
41					
42					
43					
44					
45					
46					

		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Pg. 11-13	Summary measures are given in the results section and in tables and figures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pg. 11-23 lines 406-521	Unadjusted and adjusted estimates are given in the results section and in figures
		(b) Report category boundaries when continuous variables were categorized	Pg. 11-23 lines 389-521	We have provided mean and corresponding standard deviations for the continuous variables.
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time	NA	
Continued on next page				
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	
Discussion				
Key results	18	Summarise key results with reference to study objectives	Pg. 24 lines 524--531	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Pg. 25 lines 584-596	Key limitations regarding study methods including differential response rates and sampling methods in the various study sites have been provided
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pg. 24-26 lines 522-603	Cautious overall interpretation of the key findings have been provided.
Generalisability	21	Discuss the generalisability (external validity) of the study results	Pg. 25 lines 584-596	
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Pg. 26 lines 624-630	The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

For peer review only

BMJ Open

A CROSS-SECTIONAL STUDY OF ASSOCIATION BETWEEN PSYCHOSOCIAL STRESSORS WITH CHRONIC KIDNEY DISEASE AMONG MIGRANT AND NON-MIGRANT GHANAIS LIVING IN EUROPE AND GHANA: THE RODAM STUDY

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-027931.R2
Article Type:	Research
Date Submitted by the Author:	28-May-2019
Complete List of Authors:	<p>Adjei Nana, David ; University of Ghana, Department of Medical Laboratory Sciences; University of Amsterdam, Department of Public Health</p> <p>Stronks, Karien; Academic Medical Center , Department of Public Health</p> <p>Adu, Dwomoa; Korle-bu Teaching Hospital, Department of Medicine</p> <p>Beune, Erik; AMC</p> <p>Meeks, Karlijn; AMC, Public Health</p> <p>Smeeth, Liam; London School of Hygiene and Tropical Medicine, Addo, Juliet; London School of Hygiene and Tropical Medicine, Non Communicable Disease Epidemiology</p> <p>Owusu-Dabo, Ellis; Kwame Nkrumah University of Science and Technology, Kumasi Centre for Collaborative Research in Tropical Medicine</p> <p>Klipstein-Grobusch, Kerstin; 1 Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Centre Utrecht, Utrecht, The Netherlands</p> <p>Mockenhaupt, Frank; Charité – University Medicine, Berlin, Institute of Tropical Medicine and International Health</p> <p>Schulze, Matthias; German Institute of Human Nutrition Potsdam-Rehbruecke</p> <p>Danquah, Ina; German Institute of Human Nutrition, Molecular Epidemiology; Charite Universitätsmedizin Berlin, Institute for Social Medicine, Epidemiology and Health Economy</p> <p>Spranger, Joachim; Department of Endocrinology and Metabolism, 1. Charité-University Medicine Berlin, Berlin, Germany.</p> <p>Bahendeka, Silver; St. Francis Hospital Nsambya,</p> <p>Agyemang, Charles; Academic Medical centre, University of Amsterdam, Department of Public Health</p>
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Public health, Renal medicine
Keywords:	Chronic Kidney Disease, Psychosocial stressors, migrants, rodam study, Europe, Ghana

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN PSYCHOSOCIAL
2 STRESSORS WITH CHRONIC KIDNEY DISEASE AMONG MIGRANT AND NON-
3 MIGRANT GHANAIS LIVING IN EUROPE AND GHANA: THE RODAM STUDY

4 David N. Adjei, MSc, PhD^{1,2}; Karien Stronks, MSc, PhD¹; Dwomoa Adu, MD³; Erik Beune, MSc, PhD¹;
5 Karlijn Meeks, MSc, PhD¹; Liam Smeeth, MD, PhD⁴; Juliet, Addo, MD, PhD⁴; Ellis Owusu-Dabo, MSc,
6 PhD⁵; Kerstin Klipstein-Grobusch, MSc, PhD^{6,7}; Frank P. Mockenhaupt, MD, PhD⁸; Matthias B. Schulze,
7 MSc, PhD⁹; Ina, Danquah, MSc, PhD^{9,10}; Joachim, Spranger, MD, PhD^{11,12,13}; Silver Bahendeka, MD,
8 PhD¹⁴; Charles Agyemang, MPH, PHD¹

- 9 1. Department of Public Health, Academic Medical Center, University of Amsterdam, Amsterdam,
10 Amsterdam Public Health Research Institute, Amsterdam, The Netherlands.
- 11 2. Department of Medical Laboratory Sciences, School of Biomedical and Allied Health Sciences,
12 College of Health Sciences, University of Ghana, Accra, Ghana.
- 13 3. Department of Medicine, School of Medicine and Dentistry, University of Ghana and Korle-Bu
14 Teaching Hospital, Accra, Ghana.
- 15 4. Department of Non-Communicable Disease Epidemiology, London School of Hygiene and Tropical
16 Medicine, London, United Kingdom.
- 17 5. Kumasi Centre for collaborative Research, KNUST, Kumasi, Ghana.
- 18 6. Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Centre,
19 Utrecht University, The Netherlands
- 20 7. Division of Epidemiology & Biostatistics, School of Public Health, Faculty of Health Sciences,
21 University of the Witwatersrand, Johannesburg, South Africa
- 22 8. Institute of Tropical Medicine and International Health, Charité –University Medicine Berlin,
23 Augustenburger Platz 1, 13353 Berlin, Germany.
- 24 9. Department of Molecular Epidemiology, German Institute of Human Nutrition Potsdam-Rehbrücke,
25 Nuthetal, Germany.
- 26 10. Charité - Universitaetsmedizin Berlin, Institute for Social Medicine, Epidemiology and Health
27 Economics, Berlin, Germany.
- 28 11. Department of Endocrinology and Metabolism, Charité-University Medicine Berlin, Berlin, Germany.
- 29 12. German Centre for Cardiovascular Research (DZHK), Berlin, Germany.
- 30 13. Center for Cardiovascular Research (CCR), Charité-University, Medicine, Berlin, Germany.
- 31
- 32 14. MKPGMS - Uganda Martyrs University, Kampala, Uganda.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

39 Address correspondence to David Nana Adjei, MSc, Department of Public Health, Academic Medical
40 Centre, University of Amsterdam, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands, School
41 Biomedical and Allied Health Sciences, Medical Laboratory Sciences, University of Ghana, E-mail:
42 dna@chs.edu.gh, d.n.adjei@amc.uva.nl, Tel: +233236717850

For peer review only

1
2
3 **87 Abstract**

4 **88**
5 **89 Objectives:** The association between Psychosocial stressors (PS) and CKD among sub-Saharan African
6 **90** (SSA) populations is unknown. We examined the association between PS and CKD prevalence among rural
7 **91** and urban Ghanaians and Ghanaian migrants living in three European cities. We also assessed if the
8 **92** influence of PS on CKD is partially mediated by primary risk factors (hypertension and diabetes) of CKD
9 **93**

10 **94 Design:** A multi-centred cross sectional data from the Research on Obesity and Diabetes among African
11 **95** Migrants (RODAM) study
12 **96**

13 **97 Setting:** Rural and urban Ghana and three European cities (Amsterdam, Berlin and London).
14 **98**

15 **99 Participants:** A random sample of 5,659 adults (Europe 3167, rural Ghana 1,043, and Urban Ghana 1,449)
16 **100** aged 25 to 70 years
17 **101**

18 **102 Explanatory measures:** PS defined by negative life events, perceived discrimination, perceived stress at
19 **103** work/home and depressive symptoms. Three CKD outcomes were considered using the 2012 KDIGO
20 **104** (Kidney Disease: Improving Global Outcomes) severity of CKD classification. Comparisons between PS
21 **105** and CKD outcomes were made using logistic regression analyses across all sites
22 **106**

23 **107 Results:** We observed higher proportion of negative life events (68.7%) and perceived permanent stress
24 **108** (15.9%) among Ghanaians living in Ghana than Ghanaians living in Europe. Depressive symptoms (7.5%)
25 **109** and perceived discrimination (29.7%) were more common among Ghanaians living in Europe than
26 **110** Ghanaians living in Ghana. No significant association was observed between any of the PS constructs and
27 **111** CKD outcomes across sites except for positive association between stress at work/home and albuminuria
28 **112** (2.81, 95% C.I. 1.46-5.40) and CKD risk (2.78, 95% C.I. 1.43-5.43) among Ghanaians living in Berlin
29 **113**

30 **114 Conclusion:** Our study found a positive association between stress at work/home and albuminuria and
31 **115** CKD risk. There was no convincing evidence of associations between the other PS constructs and the
32 **116** prevalence of CKD risk. Further studies, are needed to identify potential factors driving the high prevalence
33 **117** of CKD among these populations.
34 **118**

35 **119 Index Words:** Chronic kidney disease; psychosocial stressors; risk factor; migrants; RODAM study,
36 **120** Europe, Ghana
37 **121**

38 **122**

39 **123**

40 **124**

41 **125**

42 **126**

43 **127**

44 **128**

45 **129**

46 **130**

47 **131**

48 **132**

49 **133**

50 **134**

51 **135**

52 **136**

53 **137**

54

55

56

57

58

59

60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179**Strengths and limitations of the study**

- This study used all three categories of CKD definitions (albuminuria, reduced eGFR and CKD risk) by KDIGO 2012 in assessing association of SS with CKD across all sites. This provided more detailed information on CKD outcomes.
- All sites in our study used well standardized study protocols and this eliminated intra protocol variability.
- The use of four constructs of psychosocial stressors (negative life events, perceived discrimination, perceived stress at work/home and depressive symptoms) provided a robust approach to assessing SS associations with CKD.
- The limitation of intra laboratory variability in earlier studies was eliminated using the same standard operating procedures in the same laboratory for running all samples for all sites.
- PS is captured and experienced in different magnitude across different populations. We were unable to ascertain if PS as defined in this study was adequately captured among Ghanaians living in rural and urban Ghana.

1
2
3 180
4 181 **Introduction**

5 182
6 183 Worldwide, Chronic Kidney Disease (CKD) is a leading cause of mortality and morbidity with several risk
7 184 factors (diabetes mellitus, obesity, hypertension and cardiovascular disease)¹. The epidemiologic transition
8 185 in low-and-middle income countries (LMICs) shows increased burden of these risk factors²⁻⁴. CKD's high
9 186 morbidity and mortality is mostly driven by uncontrolled comorbidities such as diabetes and hypertension
10 187^{5 6}. CKD treatment and management cost is very high and not sustainable even in high-income countries
11 188 and this underscores the need for prevention⁷. Available literature has shown that both individual and
12 189 community level economic factors influence CKD⁸⁻¹⁰. However, after adjusting for both individual and
13 190 community level socioeconomic position, differences in CKD risk among different populations remained⁸
14 191^{10 11}. These findings seem to suggest that other social environmental factors may be driving CKD prevalence
15 192 and progression in high-risk populations. Recent studies have shown that whereas Ghanaians living in
16 193 Europe have a higher CKD risk compared to their host nation populations, they have a lower CKD risk
17 194 compared with their peers living in urban Ghana¹². The increased risk of CKD observed in urban Ghana
18 195 was not fully explained by conventional risk factors¹² and socio-economic status¹³. This underscores the
19 196 need to identify other modifiable risk factors of CKD for prevention, optimum treatment and efficient
20 197 management.

21 198
22 199 Evidence shows that where an individual works or stays influences his or her physiological wellbeing
23 200 leading to an increased risk of chronic diseases^{14 15}. Thus, migrants' physiological wellbeing is influenced
24 201 by the environment (host nations) they move to stay. The association between PS and CKD as well as the
25 202 biological pathways through which PS influences CKD progression is poorly understood and complex⁵
26 203 although several pathways have been suggested^{16 17}. Specifically, PS have been reported to be associated
27 204 with alteration in the sympathetic/autonomic nervous system activity leading to higher rates of traditional
28 205 risk factors of CKD including hypertension and diabetes¹⁸⁻²⁰. Environmental stressors have been reported
29 206 to contribute to the development of insulin resistance, metabolic syndrome, obesity and diabetes which if
30 207 uncontrolled leads to CKD incidence^{21 22}. Other studies^{23 24} have suggested that stress attributable to social
31 208 and/or economic disadvantage is associated with CKD development and progression through an interaction
32 209 between other psychosocial factors and comorbid behaviors such as alcohol, tobacco and drug use²⁵. In
33 210 addition, undernutrition due to stress adversely impact on fetal environment by impeding fetal growth
34 211 leading to low birth weight, which has been shown to be associated with CKD in adult life^{25 26}.

35 212
36 213 However, studies linking psychosocial stressors (PS) to CKD prevalence and progression vary greatly
37 214 among different geographical populations.^{5 16 27-31}. Specifically, in the USA whereas no association was

1
2
3 215 found between PS and CKD ³¹⁻³³ another study reported lower prevalence of CKD was associated with
4 216 greater life stressors at baseline ³¹. In contrast, in the Netherlands depressive and anxiety symptoms were
5
6 217 observed to be common among CKD patients and such patients had increased risk of poor clinical outcomes
7
8 218 ²⁸. Similarly, a study conducted in Korea reported a positive relationship between depressive symptoms and
9
10 219 CKD ²⁷. These observations suggest differential impact of PS at different geographical locations. For
11
12 220 example, discrimination among migrants may differ greatly between host population and from their SSA
13
14 221 compatriots. Specifically, some studies have reported differences in PS among rural and urban populations
15
16 222 ³⁴.
17
18 223 Current literature on the association between PS and CKD among sub-Saharan African populations and
19
20 224 their migrants in Europe is scanty and uncertain. We therefore sought to determine the association between
21
22 225 PS and CKD prevalence among Ghanaians in rural and urban Ghana and their migrants living in three
23
24 226 European cities. Furthermore, we examined the influence of psychosocial stressors on risk factors (obesity,
25
26 227 diabetes and hypertension) of CKD.

228 229 **Methods**

230 231 *Study population and study design*

232
233 For this study, data from the Research on Obesity & Diabetes among African Migrants (RODAM) study, a
234
235 multi-centre cross sectional study, were used. The rationale, conceptual framework, design and
236
237 methodology of the RODAM study have been described in detail elsewhere ^{12 13 35 36}. To summarize, the
238
239 study was conducted from 2012 to 2015. Ghanaians aged 25–70 years living in rural and urban communities
240
241 in Ghana as well as in three European cities (Amsterdam, Berlin and London) were included in this study.
242
243 We standardized data collection across all sites. The ethics committees in Ghana, the Netherlands, Germany
244
245 and the UK approved the study protocol prior to data collection. Informed consent was obtained from each
246
247 participant prior to enrollment in the study. In Ghana, participants were randomly drawn from a list of 30
248
249 enumeration areas in the Ashanti region based on the 2010 population census. These enumeration areas
250
251 came from both rural areas and two purposively selected urban cities (Kumasi and Obuasi). For Ghanaians
252
253 in Amsterdam, we randomly drew participants from the Municipal register. This register holds data on
254
255 country of birth of citizens and their parents, thus allowing for sampling based on the Dutch standard
256
257 indicator for ethnic origin. London lacked a population register for migrant groups. Thus, Ghanaian
258
259 organizations served as sampling frame for the study. Lists of these organizations were obtained from the
260
261 Ghanaian Embassy and the Association of Ghanaian Churches in the UK in the boroughs known to have
262
263 the greatest concentration of Ghanaians. Members were selected from the lists of all members of these
264
265 organizations. In Berlin, the registration office of the federal state of Berlin provided a list of Ghanaian

1
2
3 250 individuals in Berlin but this resulted in low response rate. Because of this, a change was made to use lists
4
5 251 of Ghanaian churches and organizations as the sampling frame. Across all sites in Europe, all selected
6
7 252 participants were sent a written invitation combined with written information (information sheet) regarding
8
9 253 the study and a response card. The participants were contacted by phone to schedule a date and location of
10
11 254 the interview with a trained research assistant or opt for the self-administration of the paper questionnaire
12
13 255 or digital online version depending on the preference of the participant. After the completion of the
14
15 256 questionnaire, a date for physical examination was then scheduled after a positive response. The participants
16
17 257 were instructed to fast from 10.00 p.m. the night before the physical examination. The response rate was
18
19 258 76% in rural Ghana and 74% in urban Ghana. In London, of those individuals who were registered in the
20
21 259 various Ghanaian organizations and were invited, 75% agreed and participated in the study, while in Berlin,
22
23 260 this figure was 68%, and 53% in Amsterdam. For the current study, 5898 participants with data available
24
25 261 on both questionnaire data and physical measurements were used. Individuals who were outside the age
26
27 262 range of 25–70 years (n=239) were excluded because not all the study sites had individuals outside this age
28
29 263 range resulting in 5659 individuals comprising of 2492 from rural and urban Ghana and 3167 from the three
30
31 264 European cities. In the conduct of analysis, we further excluded individuals with no data on CKD and all
32
33 265 other indicators (n=52), resulting in a data set of 5607 participants for analysis.

34 266

35 267 **Measurements**

36 268

37 269 **Covariates**

38 270 *Demographic and lifestyle factors*

39 271 For this study, we obtained information on demographics, educational level and lifestyle factors (smoking
40
41 272 and physical activity) by questionnaire. Physical examinations were performed across all sites using
42
43 273 validated devices per standardized operational procedures. Educational level was based on the highest
44
45 274 qualification gained either in the Netherlands or in the country of origin and was classified into 4 groups:
46
47 275 those who have never been to school or had elementary schooling only, those with lower vocational
48
49 276 schooling or lower secondary schooling, those with intermediate vocational schooling or
50
51 277 intermediate/higher secondary education schooling, and those with higher vocational schooling or
52
53 278 university. The four categories were further categorized into three categories by combining the second and
54
55 279 third categories. Smoking status was determined from the response to the question “Do you smoke at all?”
56
57 280 and was classified into nonsmokers and current smokers. Physical activity was assessed using the WHO
58
59 281 Global Physical Activity Questionnaire V.2. Weight was measured in light clothing and without shoes with
60
282 SECA 877 scales to the nearest 0.1 kg. Height was measured without shoes with a portable stadiometer
283
(SECA 217) to the nearest 0.1 cm. Body mass index (BMI) was calculated as weight (kg) divided by height

1
2
3 284 squared (m²). Overweight was defined as BMI of 25 to < 30 kg/m² and obesity as BMI ≥30 kg/m². Waist
4 285 circumference was measured in centimetres at the midpoint between the lower rib and the upper margin of
5 286 the iliac crest. We used the same assessor for each participant in measuring all anthropometrics and each
6 287 was measured twice; the average of the two measurements was used for analyses.

9 288 ***Predictor: SS***

11
12 289 For this study, four constructs of psychosocial stress (discrimination, perceived stress at work or at home,
13 290 negative life events and depressive symptoms) were used as explanatory variables.

15 291 ***Perceived discrimination***

16 292 Everyday discrimination as perceived by participants was reported as routinely experiencing instances of
17 293 unfair treatment. We used the Everyday Discrimination Scale (EDS). The EDS comprises of a 9-items
18 294 which rates the frequency at which participants experience daily mistreatment and it focuses on being
19 295 treated with less courtesy or less respect, receiving poorer service than other people or being called names
20 296 or insulted. Participants had the option of rating each of the 9-items from “never” = 1 to “very often” = 5.
21 297 The obtained scores were summed and an average of the scores was computed to obtain a final score of 1
22 298 to 5. This scale was used because it is commonly used for self-reported discrimination ³⁷, with consistent
23 299 high reliability among a variety of ethnicities ³⁸, comprising African migrants in the Netherland ³⁹.

30 300 ***Perceived stress at work or at home***

31 301 We defined perceived stress at work or at home as “sense of irritation, filled with anxiety, or as having
32 302 difficulties in sleeping because of circumstances at work or at home”. We used the psychological stress
33 303 scale created by the INTERHEART study ⁴⁰. Participants in the study were asked about their opinion on
34 304 frequency of stress at work and at home, and could answer “never”, “some periods”, “several periods”, or
35 305 “continually”. Both answers were then combined into a composite score and graded into four categories:
36 306 never experienced to experienced permanent stress at home or at work ⁴⁰. Due to the very small numbers in
37 307 the permanent periods of stress group, we combined experienced several periods of stress at home or at
38 308 work and permanent periods of stress at home or at work.

44 309
45 310
46 311 ***Negative life events***

47 312 The presence of major negative life events among participants was perceived as any event that could cause
48 313 acute stress to an individual. We therefore applied the well-validated and widely used List of Threatening
49 314 Experiences (LTE) ^{41 42}. The scale comprised of 12 unpleasant events participants perceived to have
50 315 experienced in the past 12 months. We used a slightly-altered version of LTE consisting of 9 unpleasant
51 316 items. We dichotomized participants into two groups namely “no negative life events” and “one or more
52 317 events” and participants in the second category were expected to have higher levels of stress ⁴².

318 *Depressive symptoms*

319 Depressive symptoms were measured by the 9-item Patient Health Questionnaire (PHQ-9). The PHQ-9
320 consists of nine items, with a response scales 0 'not at all', 1 'on several days', 2 'on more than half of the
321 days' and 3 'nearly every day'. A participant was considered to be in a significant depressed mood (SDM)
322 when one or both of the items 1 (little interest or pleasure in doing things) and 2 (feeling down, depressed,
323 or hopeless) were answered with at least 'on more than half of the days', and at least 5 of the 9 items were
324 answered with at least 'on more than half of the days'⁴³.

325 *Co-morbidity factors*

326 Blood pressure (BP) was measured three times using a validated semi-automated device (The Microlife
327 WatchBP home) with appropriate cuffs in a sitting position after at least 5min rest. The mean of the last
328 two BP measurements was used in the analyses. Hypertension was defined as systolic BP 140mmHg and/or
329 diastolic BP 90mmHg, and/or being on antihypertensive medication treatment, and/or self-reported
330 hypertension. Trained research assistants in all sites collected fasting venous blood samples according to
331 standard operation procedures, and then temporarily stored at the local research location. The stored blood
332 samples from the local research centres were transported to Berlin, Germany, according to standardized
333 procedures, for biochemical analyses. This was done to avoid intra-laboratory variability. Fasting plasma
334 glucose concentration was measured using an enzymatic method (hexokinase). We defined Type 2 diabetes
335 according to the World Health Organization diagnostic criteria (fasting glucose 7.0mmol/L, and/or current
336 use of medication prescribed to treat diabetes, and/or self-reported diabetes)⁴⁴. We assessed concentration
337 of total cholesterol using colorimetric test kits. All biochemical analyses were performed using an ABX
338 Pentra 400 Chemistry Analyzer (ABX Pentra; Horiba 90 ABX, Germany). Hypercholesterolaemia was
339 defined as total cholesterol level ≥ 6.22 mmol/L. Serum creatinine concentration (in mol/L) was determined
340 by a kinetic colorimetric spectrophotometric isotope dilution mass spectrometry calibration method (Roche
341 Diagnostics).

342 **Outcome: CKD prevalence**

343 We asked participants to bring an early morning urine sample for the analyses of albuminuria and creatinine
344 levels. Urinary albumin concentration (in μ mol/L) was measured by an immunochemical turbidimetric
345 method (Roche Diagnostics). Urinary creatinine concentration (in 1 mol/L) was measured by a kinetic
346 spectrophotometric method (Roche Diagnostics). Extensive quality checks were done inclusive of blinded
347 serial measurements. Estimated glomerular filtration rate (eGFR) was calculated using the CKDEPI (CKD
348 Epidemiology Collaboration) creatinine equation⁴⁵. Urinary albumin-creatinine ratio (ACR; expressed in
349 mg/mmol) was calculated by taking the ratio between urinary albumin and urinary creatinine. eGFR and

1
2
3 350 albuminuria were categorized according to the 2012 KDIGO classification ⁴⁶. eGFR was categorized as
4
5 351 follows: G1, 90mL/min/1.73m² (normal kidney function); G2, 60–89mL/min/1.73m² (mildly decreased);
6
7 352 G3a, 45–59mL/min/1.73m² (mildly to moderately decreased); G3b, 30–44mL/min/1.73m² (moderately to
8
9 353 severely decreased); G4, 15–29 mL/min/1.73 m² (severely decreased); and G5, <15mL/min/1.73m² (kidney
10
11 354 failure). Albuminuria categories were derived from ACR and were as follows: A1, < 3mg/mmol (normal
12
13 355 to mildly increased); A2, 3–30mg/mmol (moderately increased); and A3, > 30mg/mmol (severely
14
15 356 increased). CKD risk was categorized according to severity of kidney disease (green, low risk; yellow,
16
17 357 moderately increased risk; orange, high risk; and red, very high risk) using the combination of eGFR (G1–
18
19 358 G5) and albuminuria (A1–A3) levels defined by the 2012 KDIGO guideline ⁴⁷. Due to the small number of
20
21 359 participants in the very high-risk category of CKD (n=27), the high and very high-risk groups were
22
23 360 combined. Because of the small number of participants in the severely increased albuminuria category (A3,
24
25 361 n=62), we defined albuminuria as ACR 3mg/ mmol by combining the moderately increased (A2) and
26
27 362 severely increased (A3) categories.

28
29 363
30
31 364 Covariates assessed were age, sex, educational level and length of stay in Europe, hypertension and
32
33 365 diabetes. Length of stay was assessed for Ghanaian migrants only. Length of stay was defined as the number
34
35 366 of years lived in Europe at the time of data collection. Length of stay was controlled for due to evidence
36
37 367 suggesting that it influences mental health ⁴⁸. Other covariates were hypertension, obesity and diabetes.

38 368 39 369 ***Patient and Public Involvement***

40
41 370 Community leaders were involved in the recruitment of patients. These comprised of religious communities
42
43 371 (churches and mosques), endorsement from local key leaders and establishing relationships with healthcare
44
45 372 organizations. We also provided information on the study by involving the local media (radio and television
46
47 373 stations). We sent letters to all selected health and community authorities to notify participants of the study.
48
49 374 Team members were sent to the various communities to stay among the community and organize mini
50
51 375 clinics for a period of 1-2 weeks. Results of the study were disseminated through seminars, durbars and via
52
53 376 radio and television stations.

54 377 ***Statistical methods***

55
56 378 Characteristics of participants were expressed as absolute numbers and percentages for categorical variables
57
58 379 and means and standard deviations for continuous variables. The z-test for proportions was used to compare
59
60 380 proportions of demographic and clinical variables among the various sites and the independent t-test was
61
62 381 also used to test for mean differences between the two sites. Odds Ratios (ORs) and their corresponding
63
64 382 95% confidence intervals (CIs) were estimated by means of binary logistic regression analyses to study the

1
2
3 383 associations of albuminuria (ACR>3 mg/mmol, A2-A3, moderately to severely increased albuminuria),
4 384 reduced kidney function (eGFR< 60 mL/min/1.73m², G3-G5 moderately to severely decreased kidney
5 385 function) and increased CKD risk (high and very high CKD risk), with adjustments for covariates⁴⁹. The
6 386 Spearman's correlation test was used to test for associations between all four constructs of PS. Three models
7 387 were used to examine the data. Model 1 was adjusted for age and sex, model 2 was adjusted for age and
8 388 sex and educational level for Ghanaians living in SSA while age, sex, educational level and length of stay
9 389 for Ghanaians living in Europe⁵⁰⁻⁵². Model 3 was adjusted for sex, age, educational level and conventional
10 390 risk factors (hypertension, diabetes, hypercholesterolemia, BMI, physical activity and smoking status) of
11 391 CKD. The analyses were performed for all 4 constructs of PS using individuals who have not experienced
12 392 either of the PS per outcome as reference. All tests were stratified per sites due to interactions, Ghanaians
13 393 living in SSA and Europe; Ghanaians living in rural and urban Ghana and Ghanaians living in Amsterdam,
14 394 Berlin and London due to an observed interaction between PS and site. Furthermore, the analyses were
15 395 stratified for those with and without obesity, diabetes, hypertension across all sites due to interactions
16 396 between these disease risks. P-values less than 0.05 were interpreted as statistically significant. All analyses
17 397 were performed using STATA, version 14.0 (StataCorp LP).

27 398 **Results**

29 399 *Characteristics of the study population*

30 400
31 401 Participants characteristics are shown in Table 1. Ghanaians living in Ghana were significantly older than
32 402 their peers living in Europe (47.7±11.9 versus 46.6±9.9, p=0.006). There were more female participants in the
33 403 Ghana sample compared with European sample (67.1% versus 58.5%, p=0.001). Ghanaians living in
34 404 Ghana were significantly less educated than those living in Europe. Higher proportion of Ghanaians living
35 405 in Ghana had experienced negative life events in the last 12 months compared with their peers living in
36 406 Europe (68.7% versus 59.0%, p=0.001). More than half of Ghanaians living in Ghana had experienced
37 407 some stress at home or work whereas only a third of those living in Europe had experienced some stress at
38 408 home or work (p=0.001). Permanent stress at home/work was fairly the same among Ghanaians living in
39 409 SSA and Europe. Perceived discrimination was significantly higher among Ghanaians living in Europe
40 410 compared with their peers living in Ghana (29.7% versus 4.8%, p=0.001). Depressive symptoms were more
41 411 prevalent among Ghanaians living in Europe 7.5% compared with their peers living in Ghana 5.1%. Almost
42 412 all Ghanaians living in Europe were first generation migrants. Ghanaians in Europe were significantly more
43 413 obese, more likely to smoke and less physically active compared with their peers living in Ghana.
44 414 Prevalence of hypercholesterolemia was significantly higher, but type 2 diabetes and hypertension were
45 415 significantly lower among Ghanaians living in Ghana compared with their peers living in Europe (p=0.001).

416 Prevalence of albuminuria, reduced eGFR and CKD risk were higher in Ghanaians living in Ghana
 417 compared with those living in Europe.

418

419

420

421

422 **Table 1: Baseline characteristics of respondents**

	Ghanaians (SSA) n (%)	Ghanaians (Europe) n (%)	p-value
N	2,492 (44.1)	3,167 (55.9)	0.001
Female sex	1672 (67.1)	1,851 (58.5)	0.001
Age (years)	47.7±11.9	46.6±9.9	0.006
Educational status			
Low	1169 (49.2)	635 (21.8)	0.001
Middle	858 (36.1)	1111 (38.1)	
High	347 (14.6)	1168 (40.1)	
Negative life events in the past 12 months			
No	739 (31.3)	1158 (41.0)	0.001
Yes	1619 (68.7)	1667 (59.0)	
Perceived stress at home/work			
Never	692 (29.4)	1371 (48.8)	0.001
Some periods	1290 (54.7)	1033 (36.8)	
Several/Permanent	375 (15.9)	407 (14.4)	
Perceived discrimination			
No	2065 (95.2)	1960 (70.3)	0.001
Yes	104 (4.8)	829 (29.7)	
Depressive symptoms			
No	2239 (94.9)	2582 (92.5)	0.001

Yes	119 (5.1)	209 (7.5)	
Migration generation			
First	Not applicable	2868 (98.7)	Not applicable
Second	Not applicable	38 (1.3)	Not applicable
BMI			
Normal (<25kg/m ²)	1373 (55.2)	643 (20.4)	0.001
Overweight (25 ≤ 30kg/m ²)	684 (27.5)	1,350 (42.8)	
Obese (>30kg/m ²)	432 (17.3)	1163 (36.8)	
Currently smoking	36 (1.5)	121 (4.1)	0.001
Physical activity	1255 (52.8)	1131 (44.0)	0.001
Hypocholesteraemia	352 (14.2)	354 (11.3)	0.007
Type 2 diabetes	206 (8.3)	444 (14.0)	0.001
Hypertension	837 (33.6)	1801 (56.9)	0.001
ACR			
A1 < 3mg/mmol	2215 (90.2)	2814 (91.8)	0.001
A2-A ≥ 3mg/mmol	243 (9.8)	252 (8.2)	
eGFR			
G1-G2 ≥ 60 mL/min/1.73 m ²	2377 (96.3)	2936 (97.4)	0.018
G3a-G5 < 60 mL/min/1.73 m ²	85 (3.7)	78 (2.6)	
CKD Risk			
Low risk	2197 (89.6)	2705 (91.5)	0.015
Moderate-very high risk	256 (10.4)	252 (8.5)	

Abbreviations: N, number of respondents; BMI, body mass index; eGFR, estimated glomerular filtration rate; G1-G2, normal to high kidney function to mildly decreased; G3a-G5, mildly to moderately decreased to Kidney failure; ACR, albumin creatinine ratio; A1, normal to mildly increased; A2-A3, moderately increased to severely increased; CKD, Chronic kidney disease; SSA, Sub-Saharan Africa; CI, confidence intervals.

429 *Association between PS and CKD*

430 Figure 1-4 shows CKD prevalence by negative life events in the past 12 months among Ghanaians living
 431 in Ghana and Europe. In Europe, CKD prevalence was fairly the same among those who had experienced
 432 any negative life events compared with those who had not in the last 12 months. Prevalence of CKD was
 433 higher among Ghanaians who had not experienced any negative life events in the past 12 months (10.9%)

434 compared with those who had experienced some negative life events (9.9%) and living in Ghana. CKD
 435 prevalence was higher among Ghanaians who had not experienced any form of discrimination (10.6%) than
 436 those who had (6.7%) in Ghana as well as in Europe (Figure 2). CKD prevalence was slightly higher among
 437 Ghanaians who had experienced several/permanent stress at work/home in the past 12 months and living
 438 in Ghana (10.4%) or Europe (9.7%) (Figure 3). Ghanaians who did not report any form of depressive
 439 symptoms had a significantly higher CKD prevalence than those who did and living in Ghana (10.4%) and
 440 Europe (8.7%) (Figure 4).

441
 442 Table 2 shows the correlation matrix between the 4 constructs of PS among Ghanaians living in Ghana and
 443 those living in Europe. All four constructs of PS were positively correlated with each other among
 444 Ghanaians living in Europe and Ghanaians living in Ghana ($p < 0.001$), except stress at work/home and
 445 discrimination among Ghanaians living in Ghana.

446

447 **Table 2: Relationship between PS constructs (negative life events, discrimination, stress at**
 448 **work or home and depression) by Ghanaians (SSA) and Ghanaians (Europe)**

449

450

Correlation matrix	Negative events	Discrimination	Stress at work/home	Depression
Europe				
Negative events	1.000			
Discrimination	0.152**	1.000		
Stress at work/home	0.297**	0.161**	1.000	
Depressive symptoms	0.143**	0.136**	0.285**	1.000
Ghana				
Negative events	1.000			
Discrimination	0.079**	1.000		
Stress at work/home	0.101**	-0.032	1.000	
Depressive symptoms	0.091**	0.042	0.185**	1.000

451 ****Significant at 1%, Spearman's correlation**

452

453 Table 3 shows association between all 4 constructs of PS and CKD among Ghanaians living in Ghana and
 454 those living in Europe. There was no statistically significant association between PS and albuminuria,
 455 reduced eGFR and CKD risk among Ghanaians living in Ghana and those living in Europe except
 456 individuals living in Europe with some stress and lower risk of reduced eGFR (0.46, 95% C.I. 0.24-0.88).

1
2
3 457 Table S1 shows further adjustments for conventional risk factors of CKD. This did not show any
4
5 458 statistically significant associations between PS and albuminuria, reduced eGFR and CKD risk
6
7 459 among Ghanaians living in Ghana and Europe (Table S1). Table S2 shows further stratification
8
9 460 based on obesity status. We did not find any association between PS and CKD for obese participants and
10
11 461 those who were not obese for Ghanaians living in rural and urban Ghana and those living in Europe.
12
13 462 However, we observed an inverse association between PS and CKD among migrants who were not obese
14
15 463 but have experienced discrimination for the past 12 months (0.63 95% C.I. 0.41-0.97) (Table S2). In Table
16
17 464 S3 we stratified our analysis based on diabetic status. We did not find any associations between PS and
18
19 465 CKD for participants with and without diabetes for both Ghanaians living in rural and urban Ghana and
20
21 466 their migrant peers in Europe (Table S3). Finally, Table S4 stratified analysis by hypertension status. No
22
23 467 associations were observed between PS and CKD for individuals who had hypertension and those who did
24
25 468 not have hypertension for both those living in rural and urban Ghana as well as their compatriots living in
26
27 469 Europe. An inverse association was observed between PS and CKD among Ghanaians who have
28
29 470 experienced discrimination in the last 12 months with no hypertension and living in Europe (0.51, 95% C.I.
30
31 471 0.27-0.97). Also, we observed that having experienced some stress at home/work was inversely associated
32
33 472 with reduced eGFR among Ghanaians with hypertension and living in Europe (0.47, 95% C.I. 0. 0.23-0.95)
34
35 473 (Table S4).
36
37 474
38
39 475
40
41 476
42
43 477
44
45 478
46
47 479
48
49 480
50
51 481
52
53 482
54
55
56
57
58
59
60

483

484 **Table 3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with**
 485 **albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe**

486

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe									
No	1128 (8.2)	1.00 (Reference)	1.00 (Reference)	1106 (2.6)	1.00 (Reference)	1.00 (Reference)	1090 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	1615 (8.4)	1.03 (0.78-1.35)	1.07 (0.80-1.42)	1587 (2.5)	0.86 (0.53-1.42)	0.83 (0.49-1.39)	1557 (8.6)	0.97 (0.76-1.32)	0.99 (0.74-1.32)
Ghana									
No	732 (8.7)	1.00 (Reference)	1.00 (Reference)	736 (4.5)	1.00 (Reference)	1.00 (Reference)	732 (10.9)	1.00 (Reference)	1.00 (Reference)
Yes	1595 (3.8)	0.87 (0.65-1.16)	0.85 (0.63-1.14)	1601 (3.4)	0.69 (0.45-1.08)	0.67 (0.44-1.09)	1590 (9.9)	0.88 (0.66-1.17)	0.86 (0.64-1.15)
Discrimination									
Europe									
No	1899 (8.5)	1.00 (Reference)	1.00 (Reference)	1867 (2.6)	1.00 (Reference)	1.00 (Reference)	1832 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	810 (7.4)	0.87 (0.64-1.19)	0.92 (0.67-1.26)	791 (2.2)	0.83 (0.47-1.47)	0.84 (0.46-1.52)	782 (7.3)	0.82 (0.59-1.12)	0.84 (0.60-1.16)
Ghana									
No	2034 (10.0)	1.00 (Reference)	1.00 (Reference)	2047 (3.9)	1.00 (Reference)	1.00 (Reference)	2031 (10.6)	1.00 (Reference)	1.00 (Reference)
Yes	104 (7.7)	0.83 (0.39-1.73)	0.91 (0.67-1.24)	104 (1.9)	0.67 (0.15-2.85)	0.67 (0.16-2.84)	104 (6.7)	0.70 (0.32-1.55)	0.71 (0.32-1.55)
Stress at home/work									
Europe									
Never	1330 (8.2)	1.00 (Reference)	1.00 (Reference)	1305 (3.4)	1.00 (Reference)	1.00 (Reference)	1282 (8.5)	1.00 (Reference)	1.00 (Reference)
Some stress	1002 (7.9)	0.97 (0.72-1.31)	1.04 (0.76-1.42)	984 (1.4)	0.47 (0.26-0.87)	0.46 (0.24-0.88)	968 (8.6)	0.96 (0.71-1.30)	1.02 (0.74-1.39)
Several/Permanent stresses	397 (9.1)	1.11 (0.74-1.64)	1.153 (0.77-1.72)	390 (2.3)	0.73 (0.35-1.52)	0.76 (0.36-1.61)	383 (9.7)	1.13 (0.77-1.68)	1.19 (0.80-1.79)
Ghana									
Never	682 (10.3)	1.00 (Reference)	1.00 (Reference)	688 (3.3)	1.00 (Reference)	1.00 (Reference)	682 (9.9)	1.00 (Reference)	1.00 (Reference)

1										
2										
3	Some stress	1279 (9.5)	0.87 (0.64-1.19)	0.80 (0.59-1.11)	1279 (3.9)	1.06 (0.63-1.77)	1.11 (0.66-1.87)	1274 (10.3)	0.95 (0.69-1.30)	0.92 (0.67-1.26)
4	Several/Permanent stresses	365 (8.5)	0.75 (0.48-1.18)	0.68 (0.59-1.11)	369 (4.1)	1.13 (0.57-2.23)	1.22 (0.61-2.46)	365 (10.4)	0.96 (0.63-1.47)	0.92 (0.59-1.42)
5										
6	Depressive symptoms									
7										
8	Europe									
9										
10	No	2505 (8.5)	1.00 (Reference)	1.00 (Reference)	2457 (2.7)	1.00 (Reference)	1.00 (Reference)	2416 (8.7)	1.00 (Reference)	1.00 (Reference)
11	Yes	206 (6.3)	0.71 (0.39-1.27)	0.76 (0.43-1.36)	202 (1.5)	0.63 (0.19-2.03)	0.68 (0.21-2.23)	199 (7.1)	0.78 (0.44-1.37)	0.83 (0.47-1.46)
12										
13	Ghana									
14	No	2212 (9.9)	1.00 (Reference)	1.00 (Reference)	2222 (3.8)	1.00 (Reference)	1.00 (Reference)	2207 (10.4)	1.00 (Reference)	1.00 (Reference)
15	Yes	114 (5.3)	0.45 (0.19-1.03)	0.45 (0.19-1.01)	114 (2.6)	0.52 (0.16-1.72)	0.53 (0.17-1.74)	114 (7.9)	0.62 (0.30-1.25)	0.61 (0.30-1.24)

16 **487** Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR,
 17 **488** albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels
 18 **489** of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe

1
2
3 490 Table 4 shows associations between all 4 constructs of PS and CKD stratified by Ghanaians living
4
5 491 in urban and rural Ghana. There was no association between PS and albuminuria, reduced eGFR
6
7 492 and CKD risk among Ghanaians living rural and urban Ghana.
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

493

494 **Table 4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depressive symptoms) with**
 495 **albuminuria, reduced eGFR and CKD risk among rural and urban Ghana**

496

497

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Urban Ghana									
No	477 (11.9)	1.00 (Reference)	1.00 (Reference)	477 (4.4)	1.00 (Reference)	1.00 (Reference)	477 (12.2)	1.00 (Reference)	1.00 (Reference)
Yes	912 (10.5)	0.87 (0.61-1.23)	0.87 (0.61-1.24)	911 (3.4)	0.73 (0.41-1.31)	0.72 (0.40-1.29)	910 (10.8)	0.87 (0.61-1.24)	0.87 (0.61-1.25)
Rural Ghana									
No	255 (7.5)	1.00 (Reference)	1.00 (Reference)	259 (4.6)	1.00 (Reference)	1.00 (Reference)	255 (8.6)	1.00 (Reference)	1.00 (Reference)
Yes	683 (7.6)	0.97 (0.56-1.69)	0.94 (0.54-1.64)	690 (3.5)	0.63 (0.31-1.31)	0.66 (0.32-1.37)	680 (8.8)	0.93 (0.55-1.58)	0.92 (0.54-1.56)
Discrimination									
Urban Ghana									
No	1326 (11.1)	1.00 (Reference)	1.00 (Reference)	1326 (3.9)	1.00 (Reference)	1.00 (Reference)	1325 (11.4)	1.00 (Reference)	1.00 (Reference)
Yes	71 (8.5)	0.85 (0.36-2.00)	0.89 (0.37-2.11)	71 (2.8)	1.17 (0.27-2.09)	1.16 (0.27-2.06)	71 (7.1)	0.69 (0.27-1.77)	0.72 (0.28-1.83)
Rural Ghana									
No	708 (8.1)	1.00 (Reference)	1.00 (Reference)	721 (3.9)	1.00 (Reference)	1.00 (Reference)	706 (9.2)	1.00 (Reference)	1.00 (Reference)
Yes	33 (6.1)	0.79 (0.18-3.47)	0.84 (0.19-2.65)	33 (0.0)	***	***	33 (6.1)	0.75 (0.17-2.89)	0.83 (0.19-2.65)
Stress at home/work									
Urban Ghana									
Never	460 (10.9)	1.00 (Reference)	1.00 (Reference)	460 (3.3)	1.00 (Reference)	1.00 (Reference)	460 (10.2)	1.00 (Reference)	1.00 (Reference)
Some stress	732 (11.5)	1.04 (0.71-1.51)	0.91 (0.62-1.37)	730 (4.1)	1.27 (0.66-2.43)	1.30 (0.67-2.51)	730 (11.8)	1.13 (0.77-1.65)	1.04 (0.71-1.53)
Several/Permanent stresses	197 (9.6)	0.87 (0.50-1.52)	0.74 (0.42-1.02)	198 (3.5)	1.17 (0.46-2.84)	1.20 (0.47-3.09)	197 (11.7)	1.15 (0.68-1.71)	1.05 (0.61-1.81)

Rural Ghana

Never	222 (9.0)	1.00 (Reference)	1.00 (Reference)	228 (3.5)	1.00 (Reference)	1.00 (Reference)	222 (9.5)	1.00 (Reference)	1.00 (Reference)
Some stress	547 (6.9)	0.69 (0.39-1.23)	0.68 (0.38-1.22)	549 (3.6)	0.88 (0.38-2.07)	0.92 (0.39-2.18)	544 (8.3)	0.74 (0.42-1.30)	0.75 (0.42-1.31)
Several/Permanent stresses	168 (7.1)	0.63 (0.30-1.37)	0.60 (0.28-1.29)	171 (4.7)	1.07(0.38-3.03)	1.21(0.43-3.46)	168 (8.9)	0.71 (0.34-1.50)	0.73 (0.35-1.50)

Depressive symptoms

Urban Ghana

No	1336 (11.3)	1.00 (Reference)	1.00 (Reference)	1335 (3.8)	1.00 (Reference)	1.00 (Reference)	1334 (11.5)	1.00 (Reference)	1.00 (Reference)
Yes	52 (3.9)	0.30 (0.07-1.25)	0.30 (0.07-1.27)	52 (1.9)	0.46 (0.06-2.50)	0.45 (0.06-2.13)	52 (5.8)	0.44 (0.14-1.45)	0.45 (0.14-1.48)

Rural Ghana

No	876 (7.7)	1.00 (Reference)	1.00 (Reference)	887 (3.8)	1.00 (Reference)	1.00 (Reference)	873 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	62 (6.5)	0.67 (0.23-1.94)	0.67 (0.23-1.94)	62 (3.2)	0.58 (0.13-2.56)	0.61 (0.14-2.68)	62 (9.7)	0.82 (0.33-2.01)	0.85 (0.34-2.09)

498 Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration
 499 rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in urban and rural Ghana among the various levels of PS constructs; %, proportion of individuals with CKD
 500 among the various levels of PS constructs in rural and urban Ghana. ***, no case of CKD and therefore odds ratios were not calculated

501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516

1
2
3 517 Table 5 shows associations between all 4 constructs of PS and CKD stratified by Ghanaians living in
4 518 Amsterdam, Berlin and London. There were no associations between PS and albuminuria, reduced eGFR
5 519 and CKD risk among Ghanaians living in Europe except for positive association between stress at
6 520 work/home and albuminuria (2.81, 95% C.I. 1.46-5.40) and CKD risk (2.78, 95% C.I. 1.43-5.43) among
7 521 Ghanaians living in Berlin.
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

522

523 **Table 5: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depressive symptoms) with**
 524 **albuminuria, reduced eGFR and CKD risk among Ghanaians in three European cities.**

525

526

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Amsterdam									
No	548 (7.3)	1.00 (Reference)	1.00 (Reference)	534 (2.4)	1.00 (Reference)	1.00 (Reference)	521 (7.5)	1.00 (Reference)	1.00 (Reference)
Yes	784 (7.8)	1.08 (0.71-1.63)	1.18 (0.77-1.81)	764 (2.9)	1.11 (0.55-2.23)	1.15 (0.55-2.37)	742 (8.0)	1.06 (0.69-1.62)	1.08 (0.71-1.66)
Berlin									
No	213 (9.9)	1.00 (Reference)	1.00 (Reference)	213 (2.4)	1.00 (Reference)	1.00 (Reference)	213 (10.8)	1.00 (Reference)	1.00 (Reference)
Yes	329 (10.9)	1.12 (0.63-1.99)	1.19 (0.67-2.15)	330 (1.8)	0.64 (0.19-2.17)	0.61 (0.18-2.11)	329 (9.4)	0.86 (0.48-1.52)	0.91 (0.51-1.63)
London									
No	367 (8.7)	1.00 (Reference)	1.00 (Reference)	359 (3.1)	1.00 (Reference)	1.00 (Reference)	356 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	502 (7.8)	0.89 (0.55-1.46)	0.83 (0.49-1.41)	493 (2.2)	0.68 (0.28-1.65)	0.58 (0.22-1.51)	486 (9.1)	1.04 (0.64-1.68)	0.99 (0.58-1.68)
Discrimination									
Amsterdam									
No	956 (8.3)	1.00 (Reference)	1.00 (Reference)	935 (2.9)	1.00 (Reference)	1.00 (Reference)	909 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	363 (5.0)	0.59 (0.34-1.00)	0.59 (0.35-1.02)	349 (2.1)	0.69 (0.30-1.62)	0.81 (0.34-1.91)	342 (5.9)	0.69 (0.41-1.14)	0.69 (0.41-1.16)
Berlin									
No	329 (10.0)	1.00 (Reference)	1.00 (Reference)	329 (2.1)	1.00 (Reference)	1.00 (Reference)	329 (10.3)	1.00 (Reference)	1.00 (Reference)
Yes	209 (11.0)	1.11 (0.63-1.95)	1.16 (0.65-2.05)	210 (1.9)	0.83 (0.24-2.93)	0.82 (0.23-2.91)	209 (9.1)	0.86 (0.48-1.56)	0.89 (0.49-1.63)
London									
No	614 (7.9)	1.00 (Reference)	1.00 (Reference)	603 (2.5)	1.00 (Reference)	1.00 (Reference)	594 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	238 (7.9)	1.03 (0.59-1.81)	1.18 (0.65-2.15)	232 (2.6)	1.29 (0.46-3.59)	1.09 (0.35-3.43)	231 (7.8)	0.93 (0.53-1.63)	0.98 (0.52-1.82)
Stress at home/work									

Amsterdam

Never	634 (8.4)	1.00 (Reference)	1.00 (Reference)	622 (3.2)	1.00 (Reference)	1.00 (Reference)	603 (8.0)	1.00 (Reference)	1.00 (Reference)
Some stress	478 (5.7)	0.68 (0.42-1.11)	0.69 (0.42-1.13)	462 (1.9)	0.64 (0.29-1.43)	0.68 (0.30-1.52)	452 (6.0)	0.74 (0.45-1.20)	0.74 (0.45-1.22)
Several/Permanent stresses	210 (9.1)	1.09 (0.63-1.91)	1.12 (0.64-1.95)	204 (2.5)	0.71 (0.26-1.95)	0.77 (0.28-2.14)	198 (10.1)	1.24 (0.71-2.14)	1.26 (0.73-2.20)

Berlin

Never	250 (9.0)	1.00 (Reference)	1.00 (Reference)	250 (2.0)	1.00 (Reference)	1.00 (Reference)	250 (6.4)	1.00 (Reference)	1.00 (Reference)
Some stress	196 (15.3)	2.50 (1.33-4.71)	2.81 (1.46-5.40)	197 (1.5)	0.88 (0.20-3.79)	0.83 (0.19-3.62)	196 (14.8)	2.57 (1.34-4.90)	2.78 (1.43-5.43)
Several/Permanent stresses	96 (10.4)	1.64 (0.72-3.73)	1.69 (0.73-3.91)	197 (3.1)	2.10 (0.47-9.46)	2.04 (0.44-9.26)	76 (9.4)	1.52 (0.65-3.58)	1.58 (0.66-3.75)

London

Never	446 (9.2)	1.00 (Reference)	1.00 (Reference)	433 (4.4)	1.00 (Reference)	1.00 (Reference)	429 (10.5)	1.00 (Reference)	1.00 (Reference)
Some stress	328 (7.0)	0.73 (0.43-1.25)	0.79 (0.44-1.40)	325 (0.6)	0.17 (0.04-0.73)	0.09 (0.01-0.67)	320 (6.9)	0.65 (0.38-1.10)	0.66 (0.37-1.19)
Several/permanent stresses	91 (7.7)	0.81 (0.35-1.87)	0.86 (0.35-2.14)	90 (1.1)	0.27 (0.03-2.12)	0.24 (0.03-2.05)	74 (8.9)	0.83 (0.38-1.83)	0.92 (0.39-2.16)

Depressive symptoms

Amsterdam

No	1199 (7.8)	1.00 (Reference)	1.00 (Reference)	1135 (2.8)	1.00 (Reference)	1.00 (Reference)	1135 (7.9)	1.00 (Reference)	1.00 (Reference)
Yes	121 (6.6)	0.81 (0.39-1.72)	0.83 (0.39-1.76)	118 (1.7)	0.65 (0.15-2.77)	0.71 (0.16-3.06)	116 (6.9)	0.83 (0.39-1.76)	0.82 (0.38-1.74)

Berlin

No	503 (10.7)	1.00 (Reference)	1.00 (Reference)	504 (2.2)	1.00 (Reference)	1.00 (Reference)	503 (10.1)	1.00 (Reference)	1.00 (Reference)
Yes	34 (5.9)	0.53 (0.12-2.27)	0.49 (0.11-2.13)	34 (0.0)	***	***	34 (5.9)	0.55 (0.13-2.37)	0.52 (0.12-2.24)

London

No	803 (8.3)	1.00 (Reference)	1.00 (Reference)	785 (2.6)	1.00 (Reference)	1.00 (Reference)	778 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	51 (5.9)	0.67 (0.20-2.21)	0.91 (0.27-3.07)	50 (2.0)	0.91 (0.11-7.43)	1.15 (0.14-9.54)	49 (8.2)	0.94 (0.33-2.69)	1.30 (0.44-3.81)

527 Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, educational level and length of stay; Abbreviations: CI, confidence interval; ACR, albumin creatinine ratio; eGFR, estimated
 528 glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Amsterdam, Berlin and London among the various levels of PS constructs; %, proportion
 529 of individuals with CKD among the various levels of PS constructs in Europe ***; no case of CKD and therefore odds ratios were not calculated.

530 Discussion

531

532 Key findings

533

534 Whereas there was an association between those who have experienced some stress at home/work and
535 reduced eGFR among Ghanaians living in Europe, we did not find any association between PS and CKD
536 among Ghanaians living in rural and urban Ghana and their peers in Europe. Also, PS was not associated
537 with CKD for those living in rural and urban Ghana and neither for those living in the three European cities.
538 However, there was an association between stress at work/home and albuminuria and CKD risk among
539 Ghanaians living in Berlin. Further adjustment for conventional risk factors of CKD yielded similar results.

540

541 Discussion of key findings

542

543 Association between PS and CKD in Ghana

544

545 Our study did not find any association between any of the four constructs of PS and prevalence of CKD
546 (albuminuria, reduced eGFR and CKD risk) among Ghanaians living in rural and urban Ghana. Our findings
547 are however in contrast with earlier studies which reported positive associations between PS and prevalent
548 of CKD^{28 31 53}. Other studies have hypothesised that the influence of PS on CKD may be important in only
549 those with hypertension and diabetes and that PS may mediate or moderate the association between renal
550 functioning and lifestyle behaviours such as smoking and physical activity³³. For example, they argue that
551 stress enhances Sympathetic Nervous System (SNS) activity to increase glucocorticoid secretion and
552 inflammatory cytokines, which heavily contribute to hypertension, diabetes and vascular disease, which are
553 major risk factors of CKD incidence and prevalence⁵⁴. The lack of association between PS and CKD in
554 this present study is unclear due to lack of literature on the association between PS and CKD prevalence
555 particularly in rural and urban populations. Worth noting, however, is the presence of rich family support
556 systems in the Ghanaian context especially in rural Ghana, which may help individuals with CKD to cope
557 with PS thereby minimizing its effect. For example, patients with limited social networks and low social
558 support have been shown to have augmented risk of morbidity and mortality⁵⁵⁻⁵⁷. Specifically, there is
559 evidence that positive social support is a protective factor for persons dealing with long-term disease
560 conditions⁵⁸. Other studies have reported a protective relationship between social networks, emotionally
561 supportive relationship and threats to physiological and psychosocial health⁵⁹.

562

563 Association between PS and CKD Amsterdam, Berlin and London

564

565 Literature on the association between PS and CKD prevalence among migrants is scant and absent in most
566 European populations. The lack of positive association between PS and CKD in our study is consistent with

1
2
3 567 recent studies conducted among African Americans^{31 33} and other populations^{32 60}. Specifically, a recent
4 568 study using data from the Jackson Heart Study, which comprised of extensive constructs of psychosocial
5 569 variables reported that greater life stressors were associated with lower prevalence of CKD at baseline³¹.
6
7 570 Several studies in other parts of the world have reported a positive relationship between higher prevalence
8
9 571 of stressors and CKD risk^{27 28}, although the study findings have been inconsistent. Whereas some did not
10 572 find any associations among African Americans³¹ others found associations in other populations. Even
11 573 among those who found some associations the directions differed²⁸. Reasons for the lack of association
12 574 observed in our study among migrants are not fully understood but may reflect the real world situation.
13
14 575 First, migrants from Ghana practice both nuclear and extended family support system as their peers living
15 576 in rural and urban, this practice may mitigate the impact of stressors such as unemployment, death of a love
16 577 one, discrimination, etc. They also belong to several religious organisations such as churches, which
17 578 provide similar support systems against stressors. Moreover, there are several associations of the various
18 579 ethnic groups (Akan, Ga and Ewe) providing such support when the need arises. These systems provide
19 580 both instrumental and/or emotional social support⁶¹. These assertions are supported by several studies.
20 581 Specifically, these studies have shown that social support positively affect health outcomes through
21 582 mechanisms such as increased patient compliance with therapies, decreased levels of depressive affect,
22 583 direct physiologic effects on the immune system and improved perception of quality of life^{58 59}. The lack
23 584 of association observed in this study may also be attributed to other mechanisms, which influence the
24 585 associations between PS and CKD. Another reason for the lack of association between PS and CKD in this
25 586 study could be the cross-sectional analysis of our study. The association between PS and CKD has been
26 587 shown to be cumulative and builds over substantial period of time⁶². To effectively evaluate this,
27 588 longitudinal study design is required. This suggests the needs for more longitudinal studies in future
28 589 research in assessing the associations between PS and CKD outcomes^{62 63}.

39 590

40 591

41 592 **Strength and limitation**

42 593

43 594 Our study is the first to use all four robust constructs of PS to determine association between PS and CKD.
44 595 This gave our study a more robust definition of PS compared to other similar studies. The use of all three
45 596 definitions of CKD per KDIGO guidelines also provided a broader definition of CKD and allowed
46 597 comparison between different geographical regions. The use of a homogenous population of Ghanaians and
47 598 standardized protocols and diagnostic criteria in this study also provided a novel opportunity to compare
48 599 Ghanaians living in rural and urban Ghana and their compatriots living in Europe. There are limitations to
49 600 our study. The effect of PS on CKD has been reported to be cumulative and takes a long period of time,
50 601 therefore the use of cross-sectional design prevented us from determining the longitudinal and cumulative

1
2
3 602 effect of repeated exposure to PS among the two populations. PS is captured and experienced in different
4 603 magnitude across different populations. We were unable to ascertain if PS as defined in this study was
5 604 adequately captured among Ghanaians living in rural and urban Ghana. Lastly, the four PS measures were
6 605 assessed separately because of multicollinearity among the measures. There are several methods of
7 606 addressing multicollinearity among measures such as partial least squares regression, principal component
8 607 analysis, data reduction technique, which when used could have influenced the interpretation of the study
9 608 results.

609 610 **Conclusion**

611
612 We identified positive association between stress at work/home and albuminuria and CKD risk among
613 Ghanaians living in Berlin. Conversely, our study shows no associations between stress as indicated by four
614 PS indicators and prevalence of CKD. Consequently, there is the need to explore other factors that may be
615 responsible for the observed differences in the prevalence of CKD among Ghanaians living in rural and
616 urban Ghana and their peers living in Europe.

617 **Acknowledgement**

618 The authors are very grateful to the research assistants, interviewers and other staff of the five research
619 locations who took part in gathering the data and the Ghanaian volunteers in all the participating RODAM
620 sites. We gratefully acknowledge the advisory board members for their valuable support in shaping the
621 RODAM study methods and the Academic Medical Centre Biobank for their support in biobank
622 management and high-quality storage of collected samples.

623 624 **Contributors**

625 My co-authors have all contributed substantially to this manuscript and approve of this submission.
626 Research idea and study design: DNA, CA, KS, DA, EB, KM, JA; data acquisition and curation:
627 DNA, CA, EB, KM, data analysis/interpretation: DNA, CA, KS, DA, EB, KM, LS, JA, EOD,
628 KKG, FPM, MBS, ID, JS, SB; statistical analysis: DNA, CA, KS. DNA, CA, KS, DA, EB, KM,
629 LS, JA, EOD, KKG, FPM, MBS, ID, JS, SB; contributed important intellectual content during
630 manuscript drafting or revision and accepts accountability for the overall work by ensuring that
631 questions pertaining to the accuracy or integrity of any portion of the work are appropriately
632 investigated and resolved. DNA and CA takes responsibility that this study has been reported
633 honestly, accurately, and transparently; that no important aspects of the study have been omitted;
634 and that any discrepancies from the study as planned have been explained.

635 636 **Funding**

1
2
3 637
4 638 This work was supported by the European Commission under the Framework Programme (Grant Number:
5
6 639 278901). The funders had no role in study design, data collection and analysis, decision to publish, or
7
8 640 preparation of the manuscript. The Wellcome Trust supported Professor Smeeth's contribution, grant
9
10 641 number WT082178. Professor Joachim Spranger was supported by the DZHK (German Center for
11
12 642 cardiovascular research) and the Berlin Institute of Health (BIH).
13
14
15

16 643 **Competing interest: None Declared**
17 644

18 645 **Patient Consent:** None declared
19 646

20 647 **Ethics approval:** IRBs at each participating site.
21 648

22 649 **Data sharing statement:** Data are available from the RODAM research cohort, a third party. Dr.
23 650 Eric Beune affiliated with the RODAM research cohort and a co-author of this paper in accordance
24 651 with the RODAM requirements for collaboration. Dr. Beune is the Data Collection Coordinator of
25 652 RODAM and may be contacted with further questions (e.j.beune@amc.uva.nl). Additionally,
26 653 researchers interested in further collaboration with RODAM may see the following URL:
27 654 <http://www.rod-am.eu/>
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 672
4 673
5 674
6 675
7 676
8 677
9 678
10 679
11 680
12 681
13 682
14 683
15 684
16 685
17 686
18 687
19 688
20 689
21 690
22 691
23 692
24 693
25 694
26 695
27 696
28 697
29 698
30 699
31 700
32 701
33 702
34 703
35 704
36 705
37 706
38 707
39 708
40 709
41 710
42 711
43 712
44 713
45 714
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

References

1. Weisbord SD. Symptoms and their correlates in chronic kidney disease. *Adv Chronic Kidney Dis* 2007;14(4):319-27.
2. Correa-Rotter R, Naicker S, Katz IJ, et al. Demographic and epidemiologic transition in the developing world: role of albuminuria in the early diagnosis and prevention of renal and cardiovascular disease. *Kidney Int* 2004;66:S32-S37.
3. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet* 2012;380(9859):2095-128.
4. Katz IJ, Gerntholtz T, Naicker S. Africa and nephrology: the forgotten continent. *Nephron Clinical Practice* 2011;117(4):320-27.
5. Bruce MA, Beech BM, Sims M, et al. Social environmental stressors, psychological factors, and kidney disease. *J Investig Med* 2009;57(4):583-89.
6. Osafo C, Mate-Kole M, Affram K, et al. Prevalence of chronic kidney disease in hypertensive patients in Ghana. *Ren Fail* 2011;33(4):388-92.
7. Ojo A. Addressing the global burden of chronic kidney disease through clinical and translational research. *Trans Am Clin Climatol Assoc* 2014;125:229.
8. Norris K, Nissenson AR. Race, gender, and socioeconomic disparities in CKD in the United States. *J Am Soc Nephrol* 2008;19(7):1261-70.
9. Volkova N, McClellan W, Klein M, et al. Neighborhood poverty and racial differences in ESRD incidence. *J Am Soc Nephrol* 2008;19(2):356-64.
10. Shoham DA, Vupputuri S, Roux AVD, et al. Kidney disease in life-course socioeconomic context: the Atherosclerosis Risk in Communities (ARIC) Study. *Am J Kidney Dis* 2007;49(2):217-26.
11. Tarver-Carr ME, Powe NR, Eberhardt MS, et al. Excess risk of chronic kidney disease among African-American versus white subjects in the United States: a population-based study of potential explanatory factors. *J Am Soc Nephrol* 2002;13(9):2363-70.
12. Adjei DN, Stronks K, Adu D, et al. Chronic kidney disease burden among African migrants in three European countries and in urban and rural Ghana: the RODAM cross-sectional study. *Nephrology Dialysis Transplantation* 2018
13. Adjei DN, Stronks K, Adu D, et al. Relationship between educational and occupational levels, and Chronic Kidney Disease in a multi-ethnic sample-The HELIUS study. *PLoS One* 2017;12(11):e0186460.
14. Fremont A, Bird CE. Social and psychological factors, physiological processes, and physical health. 2000
15. Krantz DS, McCeney MK. Effects of psychological and social factors on organic disease: a critical assessment of research on coronary heart disease. *Annu Rev Psychol* 2002;53(1):341-69.

- 1
2
3 715 16. Cukor D, Fruchter Y, Ver Halen N, et al. A preliminary investigation of depression and kidney
4 716 functioning in patients with chronic kidney disease. *Nephron Clinical practice* 2012;122(3-
5 717 4):139-45.
- 7 718 17. Davidson K, Jonas BS, Dixon KE, et al. Do depression symptoms predict early hypertension
8 719 incidence in young adults in the CARDIA study? *Arch Intern Med* 2000;160(10):1495-500.
- 9 720 18. Amerena J, Julius S. The role of the autonomic nervous system in hypertension. *Hypertens*
10 721 *Res* 1995;18(2):99-110.
- 12 722 19. Calhoun DA, Mutinga ML. Race, family history of hypertension, and sympathetic response to
13 723 cold pressor testing. *Blood Press* 1997;6(4):209-13.
- 14 724 20. Dibona GF. Neural control of the kidney: past, present, and future. *Hypertension*
15 725 2003;41(3):621-24.
- 17 726 21. Auchincloss AH, Diez Roux AV, Brown DG, et al. Association of insulin resistance with distance
18 727 to wealthy areas: the multi-ethnic study of atherosclerosis. *Am J Epidemiol*
19 728 2006;165(4):389-97.
- 20 729 22. Bruce MA, Sims M, Miller S, et al. One size fits all? Race, gender and body mass index among
21 730 US adults. *J Natl Med Assoc* 2007;99(10):1152.
- 23 731 23. McEwen BS. Protective and damaging effects of stress mediators. *N Engl J Med*
24 732 1998;338(3):171-79.
- 25 733 24. Cohen S, Herbert TB. Health psychology: Psychological factors and physical disease from the
26 734 perspective of human psychoneuroimmunology. *Annu Rev Psychol* 1996;47(1):113-42.
- 28 735 25. Barker D. Fetal origins of coronary heart disease. *Br Heart J* 1993;69(3):195.
- 29 736 26. Phillips DI, Jones A, Goulden PA. Birth weight, stress, and the metabolic syndrome in adult
30 737 life. *Ann N Y Acad Sci* 2006;1083(1):28-36.
- 31 738 27. Kim JW, Moon SJ, Kim HJ, et al. Relationship between Chronic Kidney Disease and Depression
32 739 in Elderly Koreans Using the 2013 Korea National Health and Nutrition Examination
33 740 Survey Data. *Korean journal of family medicine* 2017;38(3):156-62.
- 35 741 28. Loosman WL, Rottier MA, Honig A, et al. Association of depressive and anxiety symptoms
36 742 with adverse events in Dutch chronic kidney disease patients: a prospective cohort study.
37 743 *BMC Nephrol* 2015;16(1):155.
- 39 744 29. Novak M, Mucsi I, Mendelssohn D. Screening for depression: only one piece of the puzzle.
40 745 *Nephrology Dialysis Transplantation* 2013;28(6):1336-40.
- 41 746 30. McKercher CM, Venn AJ, Blizzard L, et al. Psychosocial factors in adults with chronic kidney
42 747 disease: characteristics of pilot participants in the Tasmanian Chronic Kidney Disease
43 748 study. *BMC Nephrol* 2013;14(1):83.
- 45 749 31. Lunyera J, Davenport CA, Bhavsar NA, et al. Nondepressive Psychosocial Factors and CKD
46 750 Outcomes in Black Americans. *Clin J Am Soc Nephrol* 2018:CJN. 06430617.
- 47 751 32. Annor FB, Masyn KE, Okosun IS, et al. Psychosocial stress and changes in estimated glomerular
48 752 filtration rate among adults with diabetes mellitus. *Kidney research and clinical practice*
49 753 2015;34(3):146-53.
- 51 754 33. Gholson GK, Mwendwa DT, Wright RS, et al. The Combined Influence of Psychological Factors
52 755 on Biomarkers of Renal Functioning in African Americans. *Ethn Dis* 2015;25(2):117.
- 53 756 34. Kaur M, Kaur A, Saggu A, et al. Comparative study on psychosocial stresses among urban and
54 757 rural geriatric population in selected areas of district Ludhiana (Punjab), 2006. *Nursing*
55 758 *and Midwifery Research* 2007;3(2)

- 1
2
3 759 35. Agyemang C, Beune E, Meeks K, et al. Rationale and cross-sectional study design of the
4 760 Research on Obesity and type 2 Diabetes among African Migrants: the RODAM study. *BMJ*
5 761 *open* 2015;4(3):e004877.
6
7 762 36. Agyemang C, Snijder MB, Adjei DN, et al. Ethnic Disparities in CKD in the Netherlands: The
8 763 Healthy Life in an Urban Setting (HELIUS) Study. *Am J Kidney Dis* 2016;67(3):391-99.
9 764 37. Peek ME, Nunez-Smith M, Drum M, et al. Adapting the everyday discrimination scale to
10 765 medical settings: reliability and validity testing in a sample of African American patients.
11 766 *Ethn Dis* 2011;21(4):502.
12
13 767 38. Pérez DJ, Fortuna L, Alegria M. Prevalence and correlates of everyday discrimination among
14 768 US Latinos. *J Community Psychol* 2008;36(4):421-33.
15 769 39. Ikram UZ, Snijder MB, Fassaert TJ, et al. The contribution of perceived ethnic discrimination
16 770 to the prevalence of depression. *The European Journal of Public Health* 2014;25(2):243-
17 771 48.
18
19 772 40. Rosengren A, Hawken S, Ôunpuu S, et al. Association of psychosocial risk factors with risk of
20 773 acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the
21 774 INTERHEART study): case-control study. *The Lancet* 2004;364(9438):953-62.
22
23 775 41. Rosmalen J, Bos E, De Jonge P. Validation of the Long-term Difficulties Inventory (LDI) and the
24 776 List of Threatening Experiences (LTE) as measures of stress in epidemiological population-
25 777 based cohort studies. *Psychol Med* 2012;42(12):2599-608.
26 778 42. Brugha T, Bebbington P, Tennant C, et al. The List of Threatening Experiences: a subset of 12
27 779 life event categories with considerable long-term contextual threat. *Psychol Med*
28 780 1985;15(1):189-94.
29
30 781 43. Kroenke K, Spitzer RL, Williams JB. The phq-9. *J Gen Intern Med* 2001;16(9):606-13.
31 782 44. Association AD. Standards of Medical Care in Diabetes—2014. *Diabetes Care* 2014; 37 (Suppl.
32 783 1): S14–S80 Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 2014; 37
33 784 (Suppl. 1): S81–S90. *Diabetes Care* 2014;37(3):887-87.
34
35 785 45. Stevens LA, Schmid CH, Greene T, et al. Comparative performance of the CKD Epidemiology
36 786 Collaboration (CKD-EPI) and the Modification of Diet in Renal Disease (MDRD) Study
37 787 equations for estimating GFR levels above 60 mL/min/1.73 m². *Am J Kidney Dis*
38 788 2010;56(3):486-95.
39
40 789 46. Kellum JA, Lameire N, Aspelin P, et al. Kidney disease: improving global outcomes (KDIGO)
41 790 acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury.
42 791 *Kidney international supplements* 2012;2(1):1-138.
43
44 792 47. KDIGO G. Work Group. KDIGO clinical practice guideline for glomerulonephritis. *Kidney inter,*
45 793 *Suppl* 2012;2:139-274.
46 794 48. Rivera B, Casal B, Currais L. Length of stay and mental health of the immigrant population in
47 795 Spain: Evidence of the healthy immigrant effect. *Applied Economics* 2015;47(19):1972-82.
48 796 49. Collins AJ, Foley RN, Herzog C, et al. US Renal Data System 2010 Annual Data Report. *American*
49 797 *journal of kidney diseases: the official journal of the National Kidney Foundation*
50 798 2011;57(1 Suppl 1):A8, e1.
51
52 799 50. Fox CS, Larson MG, Leip EP, et al. Predictors of new-onset kidney disease in a community-
53 800 based population. *JAMA* 2004;291(7):844-50.
54 801 51. Banks J, Marmot M, Oldfield Z, et al. Disease and disadvantage in the United States and in
55 802 England. *JAMA* 2006;295(17):2037-45.
56
57
58
59
60

- 1
2
3 803 52. Levin A, Stevens L, McCullough PA. Cardiovascular disease and the kidney: Tracking a killer in
4 804 chronic kidney disease. *Postgrad Med* 2002;111(4):53-60.
- 5 805 53. Tsai Y-C, Chiu Y-W, Hung C-C, et al. Association of symptoms of depression with progression
6 806 of CKD. *Am J Kidney Dis* 2012;60(1):54-61.
- 7 807 54. Bruce MA, Griffith DM, Thorpe RJ. Stress and the kidney. *Adv Chronic Kidney Dis*
8 808 2015;22(1):46-53.
- 9 809 55. Brummett BH, Barefoot JC, Siegler IC, et al. Characteristics of socially isolated patients with
10 810 coronary artery disease who are at elevated risk for mortality. *Psychosom Med*
11 811 2001;63(2):267-72.
- 12 812 56. Eng PM, Rimm EB, Fitzmaurice G, et al. Social ties and change in social ties in relation to
13 813 subsequent total and cause-specific mortality and coronary heart disease incidence in
14 814 men. *Am J Epidemiol* 2002;155(8):700-09.
- 15 815 57. Psychosocial factors in patients with chronic kidney disease: The impact of social support on
16 816 end-stage renal disease. *Seminars in dialysis*; 2005. Wiley Online Library.
- 17 817 58. Cohen SD, Sharma T, Acquaviva K, et al. Social support and chronic kidney disease: an update.
18 818 *Adv Chronic Kidney Dis* 2007;14(4):335-44.
- 19 819 59. Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and
20 820 physiological processes: a review with emphasis on underlying mechanisms and
21 821 implications for health. *Psychol Bull* 1996;119(3):488.
- 22 822 60. Tsurugano S, Nakao M, Takeuchi T, et al. Job stress strengthens the link between metabolic
23 823 risk factors and renal dysfunction in adult men. *The Tohoku journal of experimental*
24 824 *medicine* 2012;226(2):101-08.
- 25 825 61. Tróccol BT. Desenvolvimento de escala para avaliação do suporte social em HIV/aids.
26 826 *Psicologia: Teoria e Pesquisa* 2006;22(3):317-26.
- 27 827 62. Schneiderman N, Ironson G, Siegel SD. Stress and health: psychological, behavioral, and
28 828 biological determinants. *Annu Rev Clin Psychol* 2005;1:607-28.
- 29 829 63. McKercher C, Sanderson K, Jose MD. Psychosocial factors in people with chronic kidney
30 830 disease prior to renal replacement therapy. *Nephrology* 2013;18(9):585-91.
- 31
32
33
34
35
36 830
37 831
38 832
39 833
40 834
41 835
42 836
43 837
44 838
45 839
46 840
47 841
48 842
49 843
50 844
51 845
52 846
53 847
54
55
56
57
58
59
60

1
2
3 **848 Legend for figures**

4 849

5 **850 Figure 1:** Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have
6 **851** not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving
7 **852** Global Outcomes) guidelines.
8 **853**

9 **854 Figure 2:** Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not
10 **855** experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global
11 **856** Outcomes) guidelines.
12 **857**

13 **858 Figure 3:** Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have
14 **859** not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO
15 **860** (Kidney Disease: Improving Global Outcomes) guidelines.
16 **861**

17 **862 Figure 4:** Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have
18 **863** depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes)
19 **864** guidelines.
20 **865**

21 866

22 867

23 868

24 869

25 870

26 871

27 872

28 873

29 874

30 875

31 876

32 877

33 878

34 879

35 880

36 881

37 882

38 883

39 884

40 885

41 886

42 887

43 888

44 889

45 890

46 891

47 892

48 893

49 894

50 895

51 896

52

53

54

55

56

57

58

59

1
2
3 897 **Legend for Supplementary Tables**
4 898

5 899 **S1: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
6 900 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
7 901 **and those living in Europe.**
8 902

9 903 **S2: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
10 904 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
11 905 **and those living in Europe stratified by obesity status.**
12 906

13 907 **S3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
14 908 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
15 909 **and those living in Europe stratified by diabetes status.**
16 910

17 911 **S4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at**
18 912 **work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana**
19 913 **and those living in Europe stratified by hypertensive status.**
20 914
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

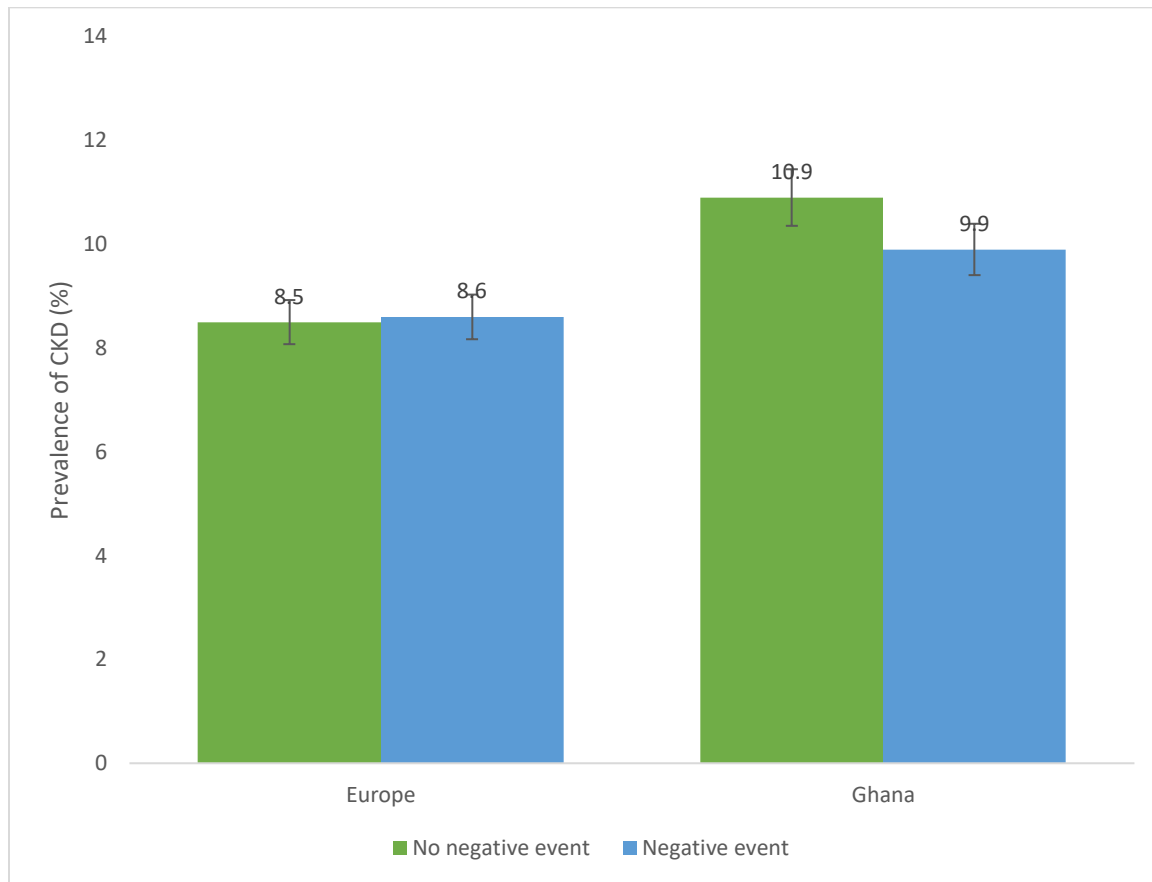


Figure 1: Prevalence of CKD risk among Ghanaians who have experienced negative life events and those who have not experienced any negative life events stratified by site. Definition per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

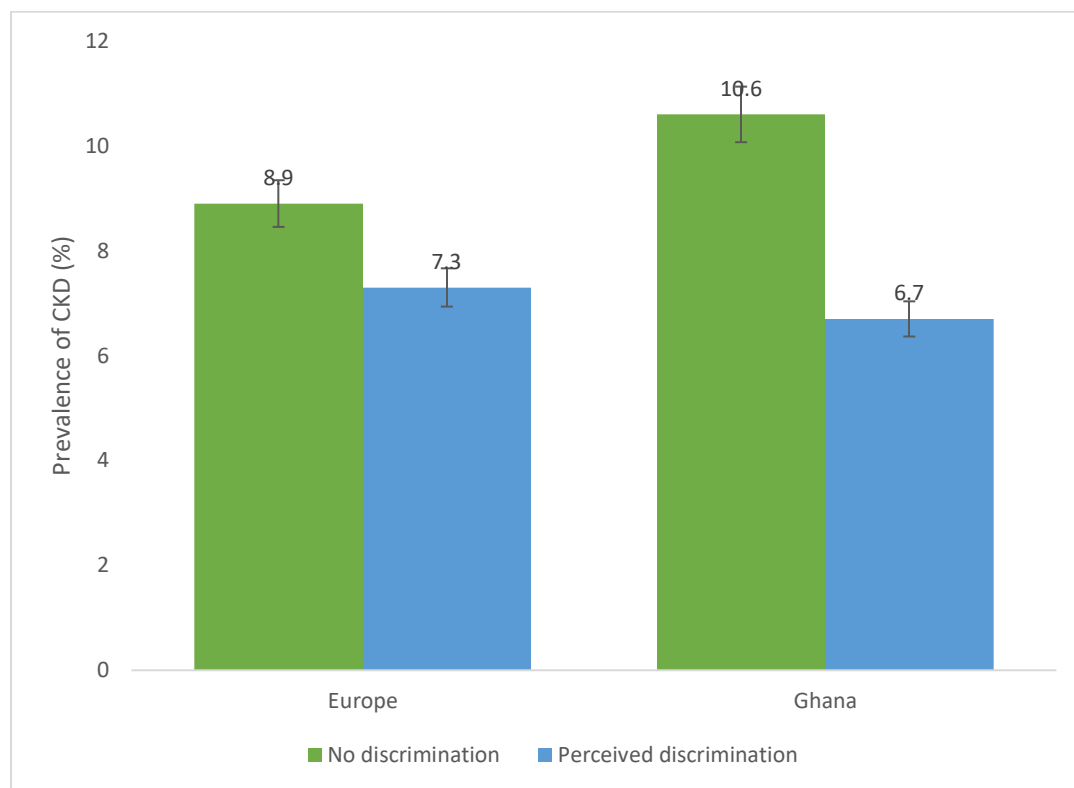


Figure 2: Prevalence of CKD risk among Ghanaians who have experienced discrimination and those who have not experienced any discrimination stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

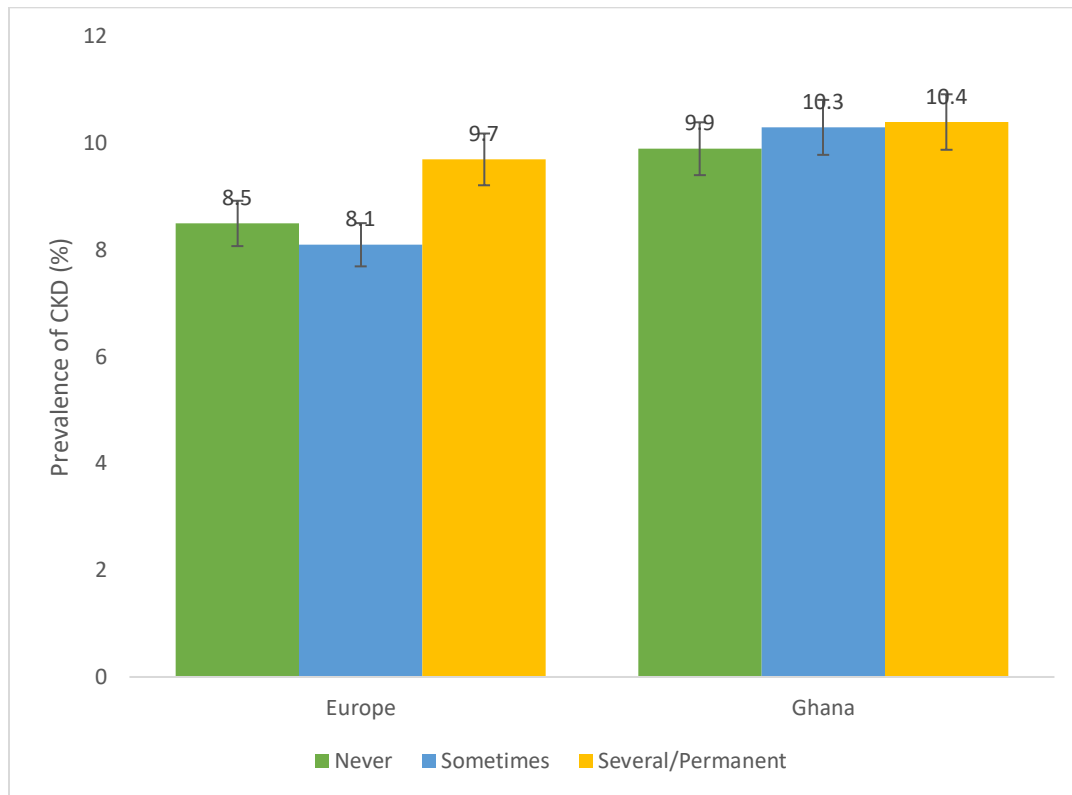


Figure 3: Prevalence of CKD risk among Ghanaians who have experienced stress at home/work and those who have not experienced any stress at home/work in the past 12 months stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

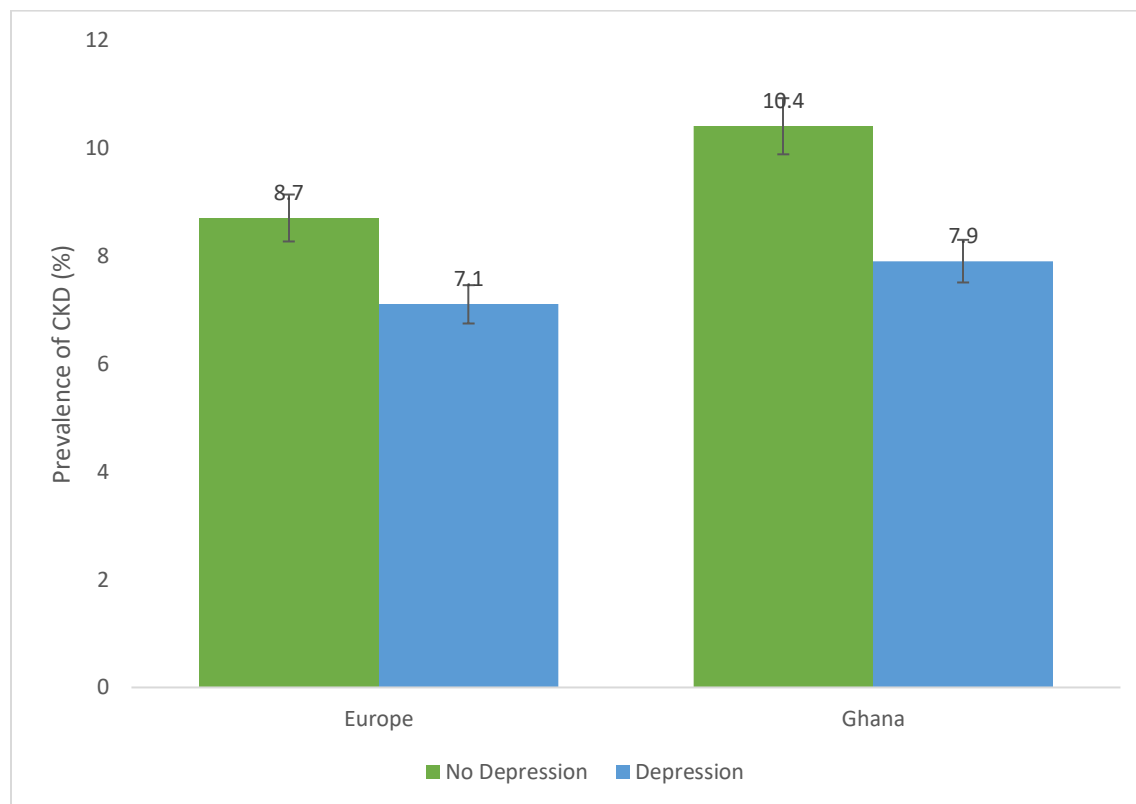


Figure 4: Prevalence of CKD risk among Ghanaians who have depressive symptoms and those who do not have depressive symptoms stratified by site. Definitions per 2012 KDIGO (Kidney Disease: Improving Global Outcomes) guidelines.

Supplementary Tables

S1: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe

	Albuminuria (ACR ≥ 3 mg/mmol)		eGFR < 60 mL/min/1.73 m2		High to very high CKD risk (KDIGO, 2012)	
	OR (95% CI)		OR (95% CI)		OR (95% CI)	
	n (%)	Model 3	n (%)	Model 3	n cases (%)	Model 3
Negative events						
Europe						
No	1128 (8.2)	1.00 (Reference)	1106 (2.6)	1.00 (Reference)	1090 (8.5)	1.00 (Reference)
Yes	1615 (8.4)	0.95 (0.70-1.30)	1587 (2.5)	0.77 (0.44-1.37)	1557 (8.6)	0.92 (0.67-1.26)
Ghana						
No	732 (10.4)	1.00 (Reference)	736 (4.5)	1.00 (Reference)	732 (10.9)	1.00 (Reference)
Yes	1595 (9.2)	0.79 (0.58-1.07)	1601 (3.4)	0.69 (0.43-1.09)	1590 (9.9)	0.79 (0.58-1.06)
Discrimination						
Europe						
No	1899 (8.5)	1.00 (Reference)	1867 (2.6)	1.00 (Reference)	1832 (8.9)	1.00 (Reference)
Yes	810 (7.4)	0.87 (0.61-1.21)	791 (2.2)	0.87 (0.45-1.65)	782 (7.3)	0.79 (0.55-1.12)
Ghana						
No	2034 (10.0)	1.00 (Reference)	2047 (3.9)	1.00 (Reference)	2031 (10.6)	1.00 (Reference)
Yes	104 (7.7)	0.92 (0.43-1.98)	104 (1.9)	0.65 (0.15-2.79)	104 (6.7)	0.74 (0.33-1.66)
Stress at home/work						
Europe						
Never	1330 (8.2)	1.00 (Reference)	1305 (3.4)	1.00 (Reference)	1282 (8.5)	1.00 (Reference)
Some stress	1002 (7.9)	1.01 (0.72-1.41)	984 (1.4)	0.51 (0.25-1.04)	968 (8.1)	1.01 (0.72-1.42)
Several/Permanent stresses	397 (9.1)	1.00 (0.64-1.59)	390 (2.3)	0.91 (0.40-2.03)	383 (9.7)	1.15 (0.74-1.79)
Ghana						

Never	682 (10.3)	1.00 (Reference)	688 (3.3)	1.00 (Reference)	682 (9.9)	1.00 (Reference)
Some stress	1279 (9.5)	0.78 (0.56-1.09)	1279 (3.9)	1.14 (0.67-1.93)	1274 (10.3)	0.93 (0.67-1.29)
Several/Permanent stresses	365 (8.5)	0.70 (0.43-1.13)	369 (4.1)	1.32 (0.65-1.68)	365 (10.4)	0.97 (0.62-1.52)
Depressive symptoms						
Europe						
No	2505 (8.5)	1.00 (Reference)	2457 (2.7)	1.00 (Reference)	2416 (8.7)	1.00 (Reference)
Yes	206 (6.3)	0.65 (0.33-1.28)	202 (1.5)	0.94 (0.28-3.14)	199 (7.1)	0.78 (0.41-1.47)
Ghana						
No	2212 (9.9)	1.00 (Reference)	2222 (3.8)	1.00 (Reference)	2207 (10.4)	1.00 (Reference)
Yes	114 (5.3)	0.41 (0.16-1.04)	114 (2.6)	0.58 (0.17-1.95)	114 (7.9)	0.62 (0.28-1.31)

Model 3, adjusted for age, sex educational level, hypertension, diabetes, hypercholesterolemia, BMI, physical activity and smoking; Abbreviations: CI, confidence interval; ACR, albumin creatinine ratio; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

S2: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by obesity status

	Albuminuria (ACR ≥ 3 mg/mmol)			eGFR < 60 mL/min/1.73 m2			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe/Not obese									
No	736 (7.4)	1.00 (Reference)	1.00 (Reference)	729 (2.5)	1.00 (Reference)	1.00 (Reference)	719 (8.5)	1.00 (Reference)	1.00 (Reference)
Yes	1003 (7.7)	0.98 (0.67-1.40)	0.99 (0.69-1.43)	992 (2.0)	0.77 (0.40-1.48)	0.71 (0.36-1.42)	971 (7.9)	0.91 (0.64-1.29)	0.89 (0.62-1.29)
Europe/Obese									
No	390 (9.2)	1.00 (Reference)	1.00 (Reference)	375 (2.9)	1.00 (Reference)	1.00 (Reference)	369 (8.7)	1.00 (Reference)	1.00 (Reference)
Yes	607 (9.6)	1.05 (0.67-1.63)	1.14 (0.72-1.82)	590 (3.2)	0.97 (0.44-2.11)	1.01 (0.44-2.26)	581 (9.6)	1.15 (0.73-1.82)	1.15 (0.71-1.85)
Ghana/Not obese									
No	588 (9.5)	1.00 (Reference)	1.00 (Reference)	592 (4.7)	1.00 (Reference)	1.00 (Reference)	588 (10.0)	1.00 (Reference)	1.00 (Reference)
Yes	1324 (8.5)	0.86 (0.61-1.21)	0.83 (0.59-1.17)	1331 (3.4)	0.64 (0.39-1.05)	0.65 (0.39-1.83)	1321 (9.0)	0.86 (0.61-1.20)	0.84 (0.60-1.18)
Ghana/Obese									
No	144 (13.9)	1.00 (Reference)	1.00 (Reference)	144 (3.5)	1.00 (Reference)	1.00 (Reference)	144 (14.6)	1.00 (Reference)	1.00 (Reference)
Yes	268 (13.1)	0.91 (0.50-1.64)	0.91 (0.49-1.65)	267 (3.8)	1.04 (0.34-3.16)	1.09 (0.35-3.37)	266 (14.3)	0.94 (0.52-1.68)	0.94 (0.52-1.67)
Discrimination									
Europe/Not obese									
No	1186 (8.4)	1.00 (Reference)	1.00 (Reference)	1172 (2.4)	1.00 (Reference)	1.00 (Reference)	1150 (9.4)	1.00 (Reference)	1.00 (Reference)
Yes	538 (5.9)	0.69 (0.46-1.05)	0.71 (0.46-1.11)	532 (1.5)	0.62 (0.28-1.37)	0.57 (0.24-1.34)	525 (5.9)	0.63 (0.42-0.96)	0.63 (0.41-0.97)
Europe/Obese									
No	709 (8.7)	1.00 (Reference)	1.00 (Reference)	691 (3.0)	1.00 (Reference)	1.00 (Reference)	678 (8.9)	1.00 (Reference)	1.00 (Reference)
Yes	269 (10.0)	1.14 (0.71-1.85)	1.29 (0.78-2.12)	256 (3.5)	1.15 (0.50-2.63)	1.27 (0.54-2.99)	254 (9.8)	1.13 (0.69-1.86)	1.22 (0.73-2.13)
Ghana/Not obese									
No	1648 (9.1)	1.00 (Reference)	1.00 (Reference)	1661 (3.9)	1.00 (Reference)	1.00 (Reference)	1646 (9.6)	1.00 (Reference)	1.00 (Reference)
Yes	81 (8.6)	1.06 (0.48-2.38)	1.04 (0.47-2.32)	81 (2.5)	1.04 (0.48-2.32)	0.86 (0.20-3.69)	81 (7.4)	0.90 (0.38-2.12)	0.89 (0.38-2.11)
Ghana/Obese									

1										
2										
3	No	383 (13.8)	1.00 (Reference)	1.00 (Reference)	383 (3.7)	1.00 (Reference)	1.00 (Reference)	382 (14.9)	1.00 (Reference)	1.00 (Reference)
4	Yes	23 (4.4)	0.31 (0.04-2.36)	0.40 (0.05-3.11)	23 (0.0)	**** (***_***)	**** (***_***)	23 (4.4)	0.29 (0.04-2.22)	0.34 (0.04-2.66)
5										
6	Stress at									
7	home/work									
8	Europe/Not obese									
9	Never	855 (7.4)	1.00 (Reference)	1.00 (Reference)	847 (3.4)	1.00 (Reference)	1.00 (Reference)	831 (8.2)	1.00 (Reference)	1.00 (Reference)
10	Some stress	629 (8.3)	1.16 (0.79-1.70)	1.20 (0.81-1.79)	627 (1.4)	0.52 (0.24-1.12)	0.47 (0.21-1.07)	615 (7.9)	0.98 (0.66-1.43)	0.98 (0.65-1.46)
11	Several/Permanent stresses	247 (6.9)	0.93 (0.53-1.62)	1.15 (0.77-1.72)	239 (2.3)	0.45 (0.13-1.52)	0.49 (0.15-1.67)	236 (9.1)	0.97 (0.57-1.65)	1.04 (0.61-1.78)
12										
13	Europe/Obese									
14	Never	472 (9.8)	1.00 (Reference)	1.00 (Reference)	455 (3.9)	1.00 (Reference)	1.00 (Reference)	448 (10.3)	1.00 (Reference)	1.00 (Reference)
15	Some stress	372 (7.5)	0.72 (0.44-1.18)	0.79 (0.47-1.32)	356 (1.4)	0.41 (0.15-1.16)	0.43 (0.15-1.21)	352 (9.5)	0.94 (0.57-1.53)	1.05 (0.62-1.76)
16	Several/Permanent stresses	147 (12.2)	1.32 (0.74-2.38)	1.31 (0.72-2.42)	148 (4.1)	1.05 (0.40-2.79)	1.09 (0.40-2.91)	144 (8.5)	1.36 (0.74-2.49)	1.41 (0.75-2.64)
17										
18	Ghana/Not obese									
19	Never	537 (9.7)	1.00 (Reference)	1.00 (Reference)	542 (3.1)	1.00 (Reference)	1.00 (Reference)	537 (8.9)	1.00 (Reference)	1.00 (Reference)
20	Some stress	1055 (8.3)	0.79 (0.56-1.15)	0.74 (0.52-1.07)	1057 (3.9)	1.16 (0.65-2.09)	1.21 (0.67-2.18)	1052 (9.0)	0.92 (0.64-1.35)	0.90 (0.62-1.32)
21	Several/permanent stresses	319 (8.5)	0.81 (0.49-1.32)	0.73 (0.44-1.20)	323 (4.3)	1.34 (0.64-2.83)	1.43 (0.67-3.04)	319 (10.7)	1.12 (0.69-1.79)	1.09 (0.68-1.76)
22										
23	Ghana/Obese									
24	Never	145 (12.4)	1.00 (Reference)	1.00 (Reference)	146 (4.1)	1.00 (Reference)	1.00 (Reference)	145 (13.8)	1.00 (Reference)	1.00 (Reference)
25	Some stress	221 (14.9)	1.21 (0.64-2.26)	1.05 (0.55-1.99)	219 (3.7)	0.74 (0.25-2.22)	0.83 (0.26-2.06)	219 (15.9)	1.13 (0.62-2.07)	1.02 (0.55-1.89)
26	Several/Permanent stresses	46 (8.7)	0.64 (0.20-2.01)	0.52 (0.16-1.65)	46 (2.2)	0.41 (0.05-3.61)	0.45 (0.05-4.01)	46 (8.8)	0.55 (0.17-1.71)	0.47 (0.14-1.50)
27										
28	Depressive symptoms									
29	Europe/Not obese									
30	No	1601 (7.9)	1.00 (Reference)	1.00 (Reference)	1586 (2.2)	1.00 (Reference)	1.00 (Reference)	1558 (8.3)	1.00 (Reference)	1.00 (Reference)
31	Yes	121 (4.9)	0.59 (0.25-1.36)	0.65 (0.27-1.48)	117 (1.7)	0.79 (0.18-2.35)	0.86 (0.21-3.80)	115 (5.22)	0.58 (0.25-1.35)	0.64 (0.27-1.49)
32										
33	Europe/Obese									
34	No	899 (9.7)	1.00 (Reference)	1.00 (Reference)	866 (3.4)	1.00 (Reference)	1.00 (Reference)	853 (9.4)	1.00 (Reference)	1.00 (Reference)
35	Yes	83 (7.2)	0.71 (0.29-1.67)	0.72 (0.30-1.74)	83 (1.2)	0.46 (0.06-3.52)	0.46 (0.06-3.57)	82 (8.5)	0.89 (0.40-2.01)	0.90 (0.40-2.04)
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Ghana/Not obese

No	1811 (8.9)	1.00 (Reference)	1.00 (Reference)	1822 (3.9)	1.00 (Reference)	1.00 (Reference)	1808 (9.4)	1.00 (Reference)	1.00 (Reference)
Yes	100 (6.0)	0.57 (0.24-1.33)	0.56 (0.24-1.32)	100 (2.0)	0.38 (0.09-1.63)	0.38 (0.09-1.63)	100 (8.0)	0.69 (0.32-1.46)	0.69 (0.32-1.47)

Ghana/Obese

No	398 (13.8)	1.00 (Reference)	1.00 (Reference)	397 (3.5)	1.00 (Reference)	1.00 (Reference)	396 (14.7)	1.00 (Reference)	1.00 (Reference)
Yes	14 (0.0)	*** (****_****)	*** (****_****)	14 (7.1)	1.76 (0.21-14.89)	2.14 (0.25-8.78)	14 (7.1)	0.42 (0.05-3.32)	0.38 (0.05-3.07)

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

For peer review only

S3: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by diabetes status

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)	Model 2	n (%)	OR (95% CI)	Model 2	n cases (%)	OR (95% CI)	Model 2
Negative events									
Europe/No diabetes									
No	986 (8.0)	1.00 (Reference)	1.00 (Reference)	971 (2.1)	1.00 (Reference)	1.00 (Reference)	957 (7.9)	1.00 (Reference)	1.00 (Reference)
Yes	1359 (7.7)	0.95 (0.70-1.29)	0.97 (0.71-1.34)	1340 (2.0)	0.90 (0.50-1.63)	0.90 (0.48-1.68)	1315 (8.1)	1.01 (0.75-1.37)	0.99 (0.72-1.36)
Europe/Diabetes									
No	142 (9.9)	1.00 (Reference)	1.00 (Reference)	135 (6.7)	1.00 (Reference)	1.00 (Reference)	133 (12.8)	1.00 (Reference)	1.00 (Reference)
Yes	256 (12.5)	1.28 (0.66-2.50)	1.41 (0.71-2.82)	247 (4.9)	0.75 (0.29-1.89)	10.68 (0.27-1.77)	242 (11.2)	0.87 (0.46-1.69)	0.96 (0.49-1.88)
Ghana/No diabetes									
No	683 (9.1)	1.00 (Reference)	1.00 (Reference)	687 (4.1)	1.00 (Reference)	1.00 (Reference)	683 (9.8)	1.00 (Reference)	1.00 (Reference)
Yes	1447 (7.7)	0.84 (0.60-1.16)	0.82 (0.59-1.14)	1451 (3.1)	0.69 (0.42-1.13)	0.69 (0.42-1.13)	1442 (8.3)	0.82 (0.59-1.12)	0.80 (0.58-1.10)
Ghana/Diabetes									
No	49 (28.3)	1.00 (Reference)	1.00 (Reference)	49 (10.2)	1.00 (Reference)	1.00 (Reference)	49 (26.4)	1.00 (Reference)	1.00 (Reference)
Yes	148 (24.3)	0.78 (0.37-1.61)	0.72 (0.34-1.52)	150 (7.3)	0.55 (0.16-1.81)	0.57 (0.17-1.88)	148 (26.4)	0.93 (0.45-1.97)	0.90 (0.43-1.92)
Discrimination									
Europe/No diabetes									
No	1629 (7.9)	1.00 (Reference)	1.00 (Reference)	1609 (2.2)	1.00 (Reference)	1.00 (Reference)	1580 (8.3)	1.00 (Reference)	1.00 (Reference)
Yes	684 (6.7)	0.85 (0.60-1.21)	0.89 (0.62-1.28)	669 (1.5)	0.68 (0.33-1.40)	0.69 (0.32-1.47)	661 (7.0)	0.84 (0.59-1.20)	0.86 (0.59-1.25)
Europe/Diabetes									
No	270 (11.9)	1.00 (Reference)	1.00 (Reference)	258 (5.4)	1.00 (Reference)	1.00 (Reference)	252 (13.1)	1.00 (Reference)	1.00 (Reference)
Yes	126 (11.1)	0.87 (0.44-1.71)	0.89 (0.45-1.76)	122 (5.7)	1.29 (0.48-3.45)	1.25 (0.46-3.37)	121 (9.1)	0.68 (0.32-1.40)	0.69 (0.33-1.42)
Ghana/No diabetes									
No	1854 (8.4)	1.00 (Reference)	1.00 (Reference)	1865 (3.5)	1.00 (Reference)	1.00 (Reference)	1851 (9.0)	1.00 (Reference)	1.00 (Reference)
Yes	99 (8.1)	1.03 (0.49-2.17)	1.04 (0.49-2.19)	99 (2.0)	0.79 (0.19-3.33)	0.78 (0.18-3.29)	99 (7.1)	0.87 (0.39-1.93)	0.88 (0.39-1.95)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Ghana/Diabetes

No	180 (26.7)	1.00 (Reference)	1.00 (Reference)	182 (7.7)	1.00 (Reference)	1.00 (Reference)	180 (27.2)	1.00 (Reference)	1.00 (Reference)
Yes	5 (0.0)	**** (***_***)	0.40 (0.05-3.11)	5 (0.0)	**** (***_***)	**** (***_***)	5 (0.0)	**** (***_***)	**** (***_***)

Stress at home/work

Europe/No diabetes

Never	1137 (7.9)	1.00 (Reference)	1.00 (Reference)	1127 (2.3)	1.00 (Reference)	1.00 (Reference)	1102 (8.0)	1.00 (Reference)	1.00 (Reference)
Some stress	860 (7.2)	0.90 (0.65-1.27)	0.96 (0.68-1.36)	850 (1.2)	0.49 (0.24-1.02)	0.49 (0.22-1.07)	835 (7.4)	0.94 (0.67-1.31)	0.99 (0.69-1.41)
Several/Permanent stresses	335 (8.4)	1.04 (0.67-1.62)	1.07 (0.68-1.70)	327 (2.1)	0.84 (0.36-1.95)	0.92 (0.39-2.17)	322 (9.6)	1.20 (0.77-1.85)	1.28 (0.82-1.99)

Europe/Diabetes

Never	193 (9.8)	1.00 (Reference)	1.00 (Reference)	184 (8.2)	1.00 (Reference)	1.00 (Reference)	180 (11.7)	1.00 (Reference)	1.00 (Reference)
Some stress	142 (12.7)	1.22 (0.61-2.45)	1.38 (0.67-2.81)	134 (3.0)	0.43 (0.13-1.39)	0.40 (0.12-1.29)	133 (12.0)	1.04 (0.52-2.09)	1.13 (0.56-2.32)
Several/Permanent stresses	62 (12.9)	1.31 (0.54-3.16)	1.38 (0.56-3.41)	63 (3.2)	0.49 (0.10-2.29)	0.46 (0.10-2.23)	61 (9.8)	0.82 (0.31-2.13)	0.89 (0.34-2.35)

Ghana/No diabetes

Never	628 (7.8)	1.00 (Reference)	1.00 (Reference)	634 (2.7)	1.00 (Reference)	1.00 (Reference)	628 (7.6)	1.00 (Reference)	1.00 (Reference)
Some stress	1163 (8.6)	1.06 (0.74-1.51)	0.97 (0.67-1.39)	1163 (3.7)	1.27 (0.71-2.27)	1.32 (0.74-2.34)	1158 (9.3)	1.15 (0.80-1.65)	1.10 (0.77-1.58)
Several/permanent stresses	339 (7.4)	0.88 (0.53-1.46)	0.76 (0.46-1.27)	341 (3.5)	1.24 (0.58-2.67)	1.35 (0.62-2.95)	339 (8.9)	1.07 (0.66-1.73)	1.00 (0.61-1.64)

Ghana/Diabetes

Never	54 (38.9)	1.00 (Reference)	1.00 (Reference)	54 (11.1)	1.00 (Reference)	1.00 (Reference)	54 (37.0)	1.00 (Reference)	1.00 (Reference)
Some stress	116 (18.9)	0.37 (0.37-0.77)	0.35 (0.17-0.75)	116 (6.0)	0.47 (0.14-1.60)	0.45 (0.12-1.55)	116 (19.8)	0.43 (0.21-0.89)	0.40 (0.19-0.86)
Several/Permanent stresses	26 (25.0)	0.44 (0.44-1.29)	0.39 (0.13-1.19)	28 (10.7)	0.65 (0.13-3.21)	0.62 (0.12-3.23)	26 (30.8)	0.69 (0.25-1.93)	0.64 (0.22-1.87)

Depressive symptoms

Europe/No diabetes

No	2154 (8.0)	1.00 (Reference)	1.00 (Reference)	2122 (2.1)	1.00 (Reference)	1.00 (Reference)	2087 (8.1)	1.00 (Reference)	1.00 (Reference)
Yes	167 (5.4)	0.63 (0.32-1.25)	0.69 (0.34-1.38)	163 (2.0)	0.65 (0.15-2.72)	0.72 (0.17-3.04)	161 (6.8)	0.58 (0.25-1.35)	0.86 (0.46-1.64)

Europe/Diabetes

1										
2										
3	No	351 (12.0)	1.00 (Reference)	1.00 (Reference)	335 (35.9)	1.00 (Reference)	1.00 (Reference)	329 (12.5)	1.00 (Reference)	1.00 (Reference)
4	Yes	39 (10.3)	0.79 (0.26-1.35)	0.73 (0.24-2.19)	39 (2.6)	0.49 (0.06-3.97)	0.49 (0.06-3.99)	38 (7.9)	0.89 (0.40-2.01)	0.60 (0.17-2.08)
5	Ghana/No									
6	diabetes									
7	No	2027 (8.3)	1.00 (Reference)	1.00 (Reference)	2035 (3.4)	1.00 (Reference)	1.00 (Reference)	2022 (8.8)	1.00 (Reference)	1.00 (Reference)
8	Yes	102 (4.9)	0.50 (0.20-1.25)	0.48 (0.19-1.19)	102 (2.9)	0.64 (0.19-2.13)	0.67 (0.20-2.21)	102 (7.8)	0.69 (0.32-1.46)	0.71 (0.34-1.51)
9	Ghana/Diabetes									
10	No	185 (26.5)	1.00 (Reference)	1.00 (Reference)	187 (8.7)	1.00 (Reference)	1.00 (Reference)	185 (27.6)	1.00 (Reference)	1.00 (Reference)
11	Yes	12 (8.3)	0.27 (0.03-2.13)	0.25 (0.03-2.01)	12 (0.0)	*** (***-***)	*** (***-***)	12 (8.3)	0.42 (0.05-3.32)	0.27 (0.03-2.19)
12										
13										
14										
15										

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

S4: Association of psychosocial stressors (PS) indicators (negative life events, discrimination, stress at work/home and depression) with albuminuria, reduced eGFR and CKD risk for Ghanaians living in Ghana and those living in Europe stratified by hypertensive status

	Albuminuria (ACR \geq 3 mg/mmol)			eGFR < 60 mL/min/1.73 m ²			High to very high CKD risk (KDIGO, 2012)		
	n (%)	OR (95% CI)		n (%)	OR (95% CI)		n cases (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
Negative events									
Europe/No hypertension									
No	568 (6.9)	1.00 (Reference)	1.00 (Reference)	562 (1.3)	1.00 (Reference)	1.00 (Reference)	551 (7.1)	1.00 (Reference)	1.00 (Reference)
Yes	743 (5.0)	0.72 (0.45-1.15)	0.78 (0.48-1.27)	740 (0.8)	0.59 (0.19-1.77)	0.60 (0.20-1.83)	724 (5.1)	0.71 (0.44-1.13)	0.75 (0.46-1.22)
Europe/Hypertension									
No	560 (9.6)	1.00 (Reference)	1.00 (Reference)	544 (4.0)	1.00 (Reference)	1.00 (Reference)	539 (10.0)	1.00 (Reference)	1.00 (Reference)
Yes	872 (11.4)	1.22 (0.86-1.73)	1.20 (0.83-1.73)	847 (3.9)	0.95 (0.54-1.67)	0.89 (0.49-1.62)	833 (11.6)	1.19 (0.83-1.69)	1.13 (0.78-1.62)
Ghana/No Hypertension									
No	540 (6.3)	1.00 (Reference)	1.00 (Reference)	543 (2.2)	1.00 (Reference)	1.00 (Reference)	540 (6.9)	1.00 (Reference)	1.00 (Reference)
Yes	1118 (5.6)	0.88 (0.57-1.36)	0.84 (0.54-1.31)	1124 (1.9)	0.82 (0.39-1.69)	0.86 (0.41-1.79)	1115 (6.4)	0.93 (0.61-1.40)	0.90 (0.59-1.36)
Ghana/Hypertension									
No	192 (21.9)	1.00 (Reference)	1.00 (Reference)	193 (10.9)	1.00 (Reference)	1.00 (Reference)	192 (22.4)	1.00 (Reference)	1.00 (Reference)
Yes	476 (18.1)	0.78 (0.52-1.18)	0.79 (0.52-1.20)	476 (6.9)	0.58 (0.32-1.04)	0.58 (0.33-1.05)	474 (18.4)	0.77 (0.50-1.16)	0.76 (0.51-1.16)
Discrimination									
Europe/No hypertension									
No	916 (6.3)	1.00 (Reference)	1.00 (Reference)	907 (0.8)	1.00 (Reference)	1.00 (Reference)	885 (6.8)	1.00 (Reference)	1.00 (Reference)
Yes	379 (3.7)	0.60 (0.33-1.09)	0.65 (0.36-1.21)	378 (1.1)	1.35 (0.39-4.74)	1.37 (0.38-4.89)	374 (3.2)	0.47 (0.25-0.89)	0.51 (0.27-0.97)
Europe/Hypertension									
No	983 (10.5)	1.00 (Reference)	1.00 (Reference)	960 (4.4)	1.00 (Reference)	1.00 (Reference)	947 (10.9)	1.00 (Reference)	1.00 (Reference)
Yes	431 (10.7)	1.03 (0.71-1.49)	1.05 (0.72-1.54)	413 (3.2)	0.73 (0.38-1.39)	0.75 (0.38-1.48)	408 (11.0)	1.03 (0.71-1.49)	1.04 (0.71-1.53)
Ghana/No hypertension									
No	1427 (5.7)	1.00 (Reference)	1.00 (Reference)	1437 (2.2)	1.00 (Reference)	1.00 (Reference)	1424 (6.5)	1.00 (Reference)	1.00 (Reference)

1										
2										
3	Yes	81 (7.4)	1.30 (0.55-3.09)	1.30 (0.55-3.10)	81 (0.0)	**** (***_***)	**** (***_***)	81 (7.4)	1.21 (0.51-2.88)	1.22 (0.51-2.89)
4	Ghana/Hyperten									
5	sion									
6	No	606 (20.3)	1.00 (Reference)	1.00 (Reference)	609 (7.9)	1.00 (Reference)	1.00 (Reference)	606 (20.3)	1.00 (Reference)	1.00 (Reference)
7	Yes	23 (8.7)	0.38 (0.09-1.68)	0.40 (0.09-1.74)	23 (8.7)	1.27 (0.28-5.70)	1.20 (0.26-5.44)	23 (4.4)	0.19 (0.03-1.44)	0.19 (0.03-1.45)

9 Stress at home/work

10 Europe/No hypertension

11	Never	644 (6.1)	1.00 (Reference)	1.00 (Reference)	640 (1.3)	1.00 (Reference)	1.00 (Reference)	625 (5.8)	1.00 (Reference)	1.00 (Reference)
12	Some stress	468 (4.5)	0.74 (0.43-1.27)	0.81 (0.46-1.43)	464 (0.4)	0.37 (0.07-1.74)	0.41 (0.09-2.01)	457 (4.8)	0.84 (0.49-1.45)	0.91 (0.52-1.60)
13	Several/Permanent stresses	192 (6.8)	1.07 (0.56-2.05)	1.19 (0.61-2.29)	191 (1.6)	1.49 (0.38-5.78)	1.52 (0.39-5.98)	186 (8.1)	1.38 (0.74-2.60)	1.49 (0.79-2.84)

17 Europe/Hypertension

18	Never	686 (10.2)	1.00 (Reference)	1.00 (Reference)	665 (5.4)	1.00 (Reference)	1.00 (Reference)	657 (11.1)	1.00 (Reference)	1.00 (Reference)
19	Some stress	534 (11.1)	1.03 (0.71-1.49)	1.05 (0.72-1.54)	520 (2.3)	0.49 (0.25-0.96)	0.47 (0.23-0.95)	511 (10.9)	0.97 (0.67-1.41)	0.99 (0.67-0.47)
20	Several/Permanent stresses	205 (11.2)	1.11 (0.67-1.82)	1.12 (0.67-1.87)	199 (3.0)	0.56 (0.23-1.37)	0.58 (0.24-1.43)	197 (11.2)	0.99 (0.59-1.64)	1.03 (0.61-1.74)

24 Ghana/No hypertension

25	Never	495 (5.5)	1.00 (Reference)	1.00 (Reference)	498 (1.4)	1.00 (Reference)	1.00 (Reference)	495 (5.9)	1.00 (Reference)	1.00 (Reference)
26	Some stress	899 (5.9)	1.07 (0.66-1.73)	0.99 (0.61-1.60)	901 (2.2)	1.30 (0.54-3.15)	1.39 (0.57-3.37)	896 (6.5)	1.04 (0.65-1.65)	1.00 (0.63-1.59)
27	Several/permanent stresses	263 (5.7)	1.01 (0.53-1.95)	0.89 (0.46-1.72)	267 (2.6)	1.69 (0.58-5.01)	1.89 (0.63-5.65)	263 (7.6)	1.21 (0.67-2.20)	1.15 (0.63-2.11)

30 Ghana/Hypertension

31	Never	187 (22.9)	1.00 (Reference)	1.00 (Reference)	190 (8.4)	1.00 (Reference)	1.00 (Reference)	187 (20.9)	1.00 (Reference)	1.00 (Reference)
32	Some stress	379 (18.2)	0.74 (0.48-1.14)	0.68 (0.43-1.05)	377 (7.9)	0.95 (0.50-1.80)	0.99 (0.51-1.91)	377 (19.4)	0.90 (0.58-1.40)	0.87 (0.55-1.36)
33	Several/Permanent stresses	102 (15.7)	0.62 (0.33-1.17)	0.54 (0.28-1.04)	102 (7.8)	0.92 (0.37-2.26)	0.97 (0.39-2.43)	102 (17.7)	0.79 (0.42-1.49)	0.76 (0.40-1.43)

37 Depressive symptoms

38 Europe/No hypertension

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

No	1195 (5.9)	1.00 (Reference)	1.00 (Reference)	1187 (1.1)	1.00 (Reference)	1.00 (Reference)	1162 (6.0)	1.00 (Reference)	1.00 (Reference)	
Yes	101 (3.9)	0.59 (0.21-1.65)	0.64 (0.23-1.82)	99 (1.0)	1.18 (0.15-2.72)	1.27 (0.16-10.17)	98 (5.1)	0.77 (0.30-1.97)	0.84 (0.33-2.17)	
Europe/Hypertension										
No	1310(10.9)	1.00 (Reference)	1.00 (Reference)	1270 (4.1)	1.00 (Reference)	1.00 (Reference)	1254 (11.2)	1.00 (Reference)	1.00 (Reference)	
Yes	105 (8.6)	0.76 (0.37-1.53)	0.75 (0.37-1.55)	103 (1.9)	0.52 (0.12-2.18)	0.56 (0.13-2.38)	101 (8.9)	0.77 (0.38-1.58)	0.80 (0.39-1.63)	
Ghana/No hypertension										
No	1575 (5.9)	1.00 (Reference)	1.00 (Reference)	1584 (2.1)	1.00 (Reference)	1.00 (Reference)	1572 (6.7)	1.00 (Reference)	1.00 (Reference)	
Yes	82 (2.4)	0.36 (0.09-1.51)	0.35 (0.08-1.44)	82 (1.2)	0.39 (0.059-2.95)	0.39 (0.05-2.97)	82 (3.7)	0.44 (0.13-1.42)	0.43 (0.13-1.40)	
Ghana/Hypertension										
No	636 (19.5)	1.00 (Reference)	1.00 (Reference)	637 (8.2)	1.00 (Reference)	1.00 (Reference)	634 (19.6)	1.00 (Reference)	1.00 (Reference)	
Yes	32 (12.5)	0.59 (0.20-1.72)	0.59 (0.20-1.74)	32 (6.3)	0.74 (0.17-3.25)	0.76 (0.17-3.33)	32 (18.8)	0.94 (0.037-2.37)	0.94 (0.38-2.37)	

Model 1, adjusted for age and sex; Model 2, adjusted for age, sex, and educational level for Ghanaians (SSA) and length of stay for those in Europe; Abbreviations: CI, confidence interval; ACR, albumin creatinine ration; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; OR, odds ratio, n= total number of Ghanaians living in Ghana and Europe among the various levels of PS constructs; %, proportion of individuals with CKD among the various levels of PS constructs in Ghana and Europe.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1 lines 1-3	We have included a commonly used term in the title and abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3 lines 87-116	Our study shows no convincing evidence for associations between stress as indicated by four PS constructs and prevalence of CKD. Further studies aimed at identifying potential factors driving the high prevalence of CKD among these populations are needed.
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5 lines 180-226	The theoretical and scientific background as well as the rationale for conducting the study have been provided in the introduction section.
Objectives	3	State specific objectives, including any pre specified hypotheses	5 lines 222-226	We examined the association between PS and CKD prevalence among rural and urban Ghanaians and their migrants living in three European cities. We also

assessed if the influence of PS on CKD is partially mediated by primary risk factors (hypertension and diabetes) of CKD.

Methods

Study design	4	Present key elements of study design early in the paper	-6-7 lines 232-264	Details given in the methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7 lines 232-264	Rural or urban Ghana and three (Amsterdam, Berlin, London) European cities (migrants)
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	Pg. 7 lines 254-264	A multi-centred cross sectional baseline data from the Research on Obesity and Diabetes among African Migrants (RODAM) study. A random sample of 5,659 adults (Europe, 3167, rural, 1,043, Urban Ghana, 1,449, Ghana) aged 25 to 70 years.
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pg. 7-10 lines 266-357	The main outcomes have been clearly defined.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pg. 7-10 lines 266-357	We defined each variable of interest in the methods

				accordingly
Bias	9	Describe any efforts to address potential sources of bias	Pg. 9 lines 315-331	Potential sources of bias have been reported in the methods sections.
Study size	10	Explain how the study size was arrived at	Pg. 7 lines 259-264	Given in the methods section and we have also referred to the RODAM study methods paper

Continued on next page

For peer review only

1					
2	Quantitative	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which	Pg. 10-11	Please see methods
3	variables		groupings were chosen and why	lines 368-	
4				388	
5					
6	Statistical	12	(a) Describe all statistical methods, including those used to control for confounding	Pg. 10-11	Please see methods
7	methods			lines 367-	
8				387	
9					
10			(b) Describe any methods used to examine subgroups and interactions	Pg. 10-11	Please see methods
11				lines 367-	
12				387	
13					
14			(c) Explain how missing data were addressed	Pg. 7 lines	
15				259-264	
16			(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	NA	We have reported non-response
17			<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed		across sites
18			<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling		
19			strategy		
20					
21			(e) Describe any sensitivity analyses	NA	
22					
23	Results				
24	Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined	Pg. 7 lines	Non-response analysis was done to
25			for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	254-264	shed light on the differential
26					response rates across sites
27			(b) Give reasons for non-participation at each stage	Pg. 7 lines	
28				259-264	
29					
30			(c) Consider use of a flow diagram	Pg. 6 lines	We have also referred to RODAM
31				232-234	methods paper
32	Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on	Pg. 7 lines	We have also referred to RODAM
33			exposures and potential confounders	269-357	methods paper
34			(b) Indicate number of participants with missing data for each variable of interest	Pg. 7 lines	We have also referred to RODAM
35				260-264	methods paper
36					
37			(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	NA	
38	Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	NA	
39			<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	NA	
40					
41					
42					
43					
44					
45					
46					

		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Pg. 11-13	Summary measures are given in the results section and in tables and figures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pg. 11-23 lines 406-521	Unadjusted and adjusted estimates are given in the results section and in figures
		(b) Report category boundaries when continuous variables were categorized	Pg. 11-23 lines 389-521	We have provided mean and corresponding standard deviations for the continuous variables.
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time	NA	
Continued on next page				
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA	
Discussion				
Key results	18	Summarise key results with reference to study objectives	Pg. 24 lines 524--531	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Pg. 25 lines 584-596	Key limitations regarding study methods including differential response rates and sampling methods in the various study sites have been provided
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pg. 24-26 lines 522-603	Cautious overall interpretation of the key findings have been provided.
Generalisability	21	Discuss the generalisability (external validity) of the study results	Pg. 25 lines 584-596	
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Pg. 26 lines 624-630	The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

For peer review only