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# **BMJ Open**

# A systematic review of diagnostic and prognostic models of chronic kidney disease in low- and middle- income countries

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Complete List of Authors:	Aparcana-Granda, Diego J.; School of Medicine 'Alberto Hurtado', Universidad Peruana Cayetano Heredia, Lima, Peru; CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru Ascencio, Edson J.; School of Medicine 'Alberto Hurtado', Universidad Peruana Cayetano Heredia, Lima, Peru; Emerge, Emerging Diseases and Climate Change Research Unit, School of Public Health and Administration, Universidad Peruana Cayetano Heredia, Lima, Peru Carrillo Larco, Rodrigo M.; Imperial College London,
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Diego J. Aparcana-Granda<sup>1,2</sup>, Edson J. Ascencio<sup>1,3</sup>, Rodrigo M. Carrillo-Larco<sup>2,4\*</sup>

<sup>1</sup> School of Medicine 'Alberto Hurtado', Universidad Peruana Cayetano Heredia, Lima, Peru

<sup>2</sup> CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru

<sup>3</sup> Emerge, Emerging Diseases and Climate Change Research Unit, School of Public Health and Administration, Universidad Peruana Cayetano Heredia, Lima, Peru

<sup>4</sup> Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK

\*Corresponding author (RMCL)

Email: rcarrill@ic.ac.uk

**Objective:** To summarize available chronic kidney disease (CKD) diagnostic and prognostic models in Low- and Middle-Income countries (LMIC)

**Method:** Systematic review (PRISMA guidelines). We searched Medline, Embase, Global Health, Scopus and Web of Science. We first screened titles and abstracts, and then studied in detail the selected reports; both phases were conducted by two reviewers independently. We followed the CHARMS recommendations and used the PROBAST for risk of bias was assessment.

**Results:** The search retrieved 14,845 results, 11 reports were studied in detail and nine (n= 61,134) were included in the qualitative analysis. The proportion of women in the study population varied between 24.5%-76.6%, and the mean age ranged between 41.8-57.7 years. Prevalence of undiagnosed chronic kidney disease ranged between 1.1%-29.7%. Age, diabetes mellitus and sex were the most common predictors in the diagnostic and prognostic models. Outcome definition varied greatly, mostly consisting of urinary albumin-to-creatinine ratio and estimated glomerular filtration rate. The highest performance metric was the negative predictive value. All studies exhibited high risk of bias, and some had methodological limitations.

**Conclusion:** There is no strong evidence to support the use of a CKD diagnostic or prognostic model throughout LMIC. The development, validation and implementation of risk scores must be a research and public health priority in LMIC to enhance CKD screening to improve timely diagnosis.

**Keywords:** population health; prognosis research; non-communicable diseases

- An extensive search was conducted, involving five major databases (Medline, Embase,
   Global Health, Scopus and Web of Science).
- A comprehensive list of available CKD diagnostic and prognostic models and their limitations is provided, which were not previously accounted for the LMIC population.
- This study adhered to PRISMA, CHARMS and PROBAST guidelines.
- Meta-analysis was not possible due to the heterogeneity in the measurement of outcomes.
- Additional data sources such as grey literature were not retrieved.



#### INTRODUCTION

Chronic kidney disease (CKD) is a condition with a large burden globally. Between 1990 and 2017, the health metrics of CKD showed a bleak profile: mortality, incidence and kidney transplantation rates increased by 3%, 29% and 34%, respectively.¹ CKD led to 1.2 million deaths in 2017 and in the best-case scenario, CKD mortality will increase to 2.2 million deaths and become the 5<sup>th</sup> cause of years of life lost (YLL) by 2040.² CKD reveals disparities between low- and middle-income countries (LMIC) and high-income countries (HIC). In the period 1990-2016, the age-standardised disability-adjusted life-years (DALY) due to CKD was the highest in LMIC,³ where they need to optimize CKD early diagnosis.

Risk scores are a cost-effective alternative for CKD screening and early diagnosis.<sup>4</sup> These equations require less resources and contribute to decision making,<sup>5</sup> and allow screening large populations.<sup>4</sup> Many of the available CKD risk scores have been developed in HIC,<sup>6-8</sup> and they may not be used in LMIC without recalibration to secure accurate predictions. How many CKD risk scores there are for LMIC, and what their strengths and limitations are, remains largely unknown.<sup>9 10</sup> This limits our knowledge of what tools there are to enhance CKD screening in LMIC. Similarly, this lack of evidence prevents planning research to overcome the limitations of available models. To fill these gaps and to inform CKD screening strategies in LMIC, we summarized available CKD diagnostic and prognostic models in LMIC.

#### **METHODS**

#### **Protocol and registration**

This systematic review and critical appraisal of the scientific literature was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (PRISMA) statement<sup>11</sup> (S1 Table). Protocol is available elsewhere<sup>12</sup> and in the S1 Text. We followed the CHecklist for critical Appraisal and data extraction for systematic Reviews of prediction Modelling Studies (CHARMS) guidelines.<sup>13 14</sup>

#### Information sources

We searched Medline, EMBASE, Global Health (these three through OVID), Scopus and Web of Science from inception to April 9<sup>th</sup>, 2021, April 17<sup>th</sup>, 2021 and April 18<sup>th</sup>, 2021, respectively. The

search strategy is available in S2 Table. We also screened the references of relevant systemic reviews<sup>10</sup> and of the selected studies.

### Eligibility criteria

 We sought diagnostic and prognostic models which assessed the current CKD status (i.e., diagnostic) or future CKD risk (i.e., prognostic), aiming to inform physicians, researchers and the general population (Table 1). Reports could include model derivation, external validation or both. The target population was adults (≥18 years) in LMIC according to The World Bank.<sup>15</sup>

#### Study selection

Reports were selected if the study population included people who were from and currently living in LMIC. Cross-sectional (diagnostic models) and longitudinal studies (prognostic models) with a random sample of the general population were included. The outcome was CKD based on a laboratory or imaging test (isolated or in combination with self-reported diagnosis): urine albumincreatinine ratio, urine protein-creatinine ratio, albumin excretion ratio, urine sediment, kidney images, kidney biopsy or the estimated glomerular filtration rate (eGFR).<sup>12</sup>

Reports had to present the development and/or validation of a multivariable model. On the other hand, reports with LMIC populations outside LMIC, or those including foreigners living in LMIC, were excluded. Reports that only studied people with underlying conditions (e.g., patients with diabetes), people with a specific risk factor (e.g., alcohol consumption), or a hospital-based population, were excluded. We also excluded models that were developed using machine learning techniques.

#### **Data collation**

We used EndNote20 and Rayyan<sup>16</sup> to remove duplicates from the search results. We used Rayyan<sup>16</sup> to screen titles and abstracts by two reviewers independently (DJA-G and EJA); discrepancies were solved by consensus. Two reviewers independently (DJA-G and EJA) studied the full length of the reports selected in the screening phase; discrepancies were solved by consensus. If consensus was not reached, a third party was consulted (RMC-L). A data extraction form based on the CHARMS guidelines<sup>14</sup> was developed and not modified during data collation. Data was extracted as presented in the original reports by two reviewers independently (DJA-G and EJA); discrepancies were solved by consensus.

 We used the PROBAST (Prediction model Risk of Bias ASsessment Tool) to assess the risk of bias of diagnostic and prognostic models.<sup>17 18</sup> Two reviewers (EJA and DJA-G) independently ascertained the risk of bias of individual reports; discrepancies were solved by consensus or a third party (RMC-L).

#### Synthesis of results

A qualitative synthesis was conducted whereby the characteristics of the selected models was comprehensively described.<sup>12</sup> Quantitative analysis (meta-analysis) was not conducted because the selected models used different predictors and they had different outcome definitions.

#### **Ethics**

This review was deemed as a low risk because human subjects were not directly involved. The funder did not have any role in the conception, conduction, results interpretation, and drafting of this work. Results and opinions expressed in the article are entirely the author's alone responsibility.

#### **RESULTS**

#### Reports selection

The search yielded 14,845 reports. After removing duplicates (1,462 articles), we screened 13,383 titles and abstracts. Then, 11 reports were selected, one of them was not available as full-text,<sup>19</sup> and the rest (10 articles) were studied in detail. We excluded one report because the study population was selected by convenience,<sup>20</sup> and another report because it was conducted in a HIC.<sup>21</sup> Additionally, one report was identified by reference searching.<sup>22</sup> Finally, nine reports (n=61,134) were included in the qualitative synthesis (Figure 1).

#### General characteristics of the selected reports

Original reports were from Iran,<sup>23</sup> India,<sup>24</sup> Peru, <sup>25</sup> South Africa, <sup>22</sup> two from China<sup>26</sup> <sup>27</sup> and three from Thailand<sup>28-30</sup> (S1 Figure). All studies were developed on community-based populations with random sampling (S3 Table).

Overall, Wu and colleagues studied the largest sample size (n=14,374) which was a population of workers who underwent health checks;<sup>27</sup> conversely, the smallest sample was studied by Mogueo *et al* (n=902).<sup>22</sup> The oldest data was collected in 1999<sup>23</sup> whereas the most recent one dated from 2018.<sup>23</sup>

The number of CKD cases varied greatly in the derivation models, from 81<sup>25</sup> to 947;<sup>24</sup> the corresponding numbers in the validation models were 27<sup>29</sup> and 1,359<sup>23</sup>. Of note, number of CKD cases could not be extracted from the validation work by Bradshaw *et al*<sup>24</sup>. The ratio of outcome events per number of candidate predictors in the derivation models ranged from 2.3<sup>25</sup> to 135.3<sup>24</sup>. This ratio could not be calculated for the derivation models by Wen *et al*<sup>26</sup> and Wu *et al*<sup>27</sup>. Across all reports, missing data were handled by conducting a complete-case analysis;<sup>22-29</sup> this information was not available in the study by Thakkinstian's *et al*<sup>30</sup> (Table 2; S3 Table).

#### What has been done?

In 2020, Asgari and colleagues prospectively validated a model from the Netherlands for 6- and 9years CKD prediction, i.e. they provided estimates for two model validations.<sup>23</sup> In 2019, Bradshaw *et al* used cross-sectional data to derive four models, one of them was validated on two populations
(rural and urban), i.e. they provided estimates for six models (four derivations and two validations).<sup>24</sup>
In 2017, Carrillo-Larco *et al* used cross-sectional data to derive and validate two models, i.e., they
provided estimates for four models (two derivations and two validations).<sup>25</sup> In 2015, Mogueo *et al*used cross-sectional data to validate two models that were previously developed in Korea and
Thailand using two different outcome definitions for each model, i.e., they provided estimates for four
model validations.<sup>22</sup> In 2017, Saranburut *et al* prospectively validated the Framingham Heart Study
risk score on a cohort using two different outcome definitions, i.e., they provided estimates for two
model validations.<sup>28</sup> In 2017, Saranburut *et al* prospectively developed four models and validated two
of them using cohort data, i.e., they provided estimates for six models (four derivations and two
validations).<sup>29</sup> In 2011, Thakkinstian *et al* derived one model using cross-sectional data.<sup>30</sup> In 2020,
Wen *et al* prospectively derived two models.<sup>26</sup> In 2016, Wu *et al* used cross-sectional data to derive
and validate one model, i.e., they provided estimates for two models (one derivation and one

#### **Outcome ascertainment**

Across all reports, CKD was defined as eGFR <60 mL/min/1.73m<sup>2</sup> <sup>22-30</sup> assessed by either the Modification of Diet Renal Disease (MDRD) formula<sup>22</sup> <sup>23</sup> <sup>25</sup> <sup>26</sup> <sup>28</sup> <sup>30</sup> or the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula.<sup>24</sup> <sup>27-29</sup> In addition to the eGFR assessment, Bradshaw *et al*<sup>24</sup> and Wen *et al*<sup>26</sup> defined CKD as a urinary albumin-to-creatinine ratio (UACR) ≥30 mg/g. Mogueo *et al* validations also considered CKD as any nephropathy including stages I to V of the "Kidney Disease: Improving Global Outcomes (KDIGO)" classification.<sup>22</sup> Thakkinstian *et al*, also considered CKD as eGFR ≥60 mL/min/1.73m<sup>2</sup> if it had haematuria or UACR ≥30 mg/g <sup>30</sup> (Table 2).

#### Predictors and modelling

Logistic regression analysis was conducted in all derivation models.<sup>24-27</sup> <sup>29 30</sup> Selection of the final predictors was based on modelling techniques: backward<sup>24 25</sup> and forward selection<sup>26 27</sup> <sup>29 30</sup> (S3 Table). All studies categorized numerical variables. The most frequent predictors included in the models were: age, diabetes mellitus and sex (S2 Figure).

#### Model performance

All studies reported calibration and discrimination metrics, except for the validations by Bradshaw *et al*<sup>24</sup> and Carrillo Larco *et al*<sup>25</sup> (S3 Table). Regarding discrimination metrics, the area under the Receiver Operating Characteristic (ROC) curve and C-statistic were over 63%<sup>28</sup> and 70%,<sup>24</sup> respectively. Among all studies, sensibility ranged from 56.8%<sup>26</sup> to 84.0%,<sup>22</sup> specificity ranged from 65.1%<sup>26</sup> to 86.3%,<sup>27</sup> positive predictive value (PPV) ranged from 8.8%<sup>25</sup> to 33.8%,<sup>26</sup> and negative predictive value (NPV) ranged from 89.4%<sup>26</sup> to 99.1%.<sup>25</sup> The NPV was the best metric, consistently above 89.4% (Table 3).

- All studies showed a high risk of bias due to insufficient or inadequate analytical reporting. The flaw regarding the analysis criteria can be explained by how original reports handled missing data and predictors categorization. The participants and predictors criteria had low risk of bias in most of the reports. Most of the individual reports demonstrated an inappropriate evaluation of performance
- 6 metrics. <sup>23 25-30</sup> Low applicability concern was noted (Table 4; S4Table).

#### DISCUSSION

#### Main findings

This systematic review summarized all available risk scores for CKD in LMIC. In so doing, we provided the most comprehensive list of CKD risk scores to enhance primary prevention and early diagnosis of CKD in LMIC. Although the available models had acceptable discrimination metrics and, when available, acceptable calibration metrics, these models had serious methodological limitations such as a reduced number of outcome events. The best performance metric across risk scores was the negative predictive value. Overall, CKD risk prediction tools in LMIC need rigorous development and validation so that they can be incorporated into clinical practice and interventions. The available evidence would not support using any of the available CKD risk scores across LMIC.

### Limitations of the review

We did not search grey literature. We argue that this limitation would not substantially change our results because these sources are most likely not to have included a random sample of the general population, and are likely to have included a small sample size with few outcome events. That is, we would not expect to find a report in the grey literature with a much better methodology than that of the studies herein summarised.

### Limitations of the selected reports

- Several LMIC do not have a CKD risk score, particularly countries in Central America and Oceania.
- 25 This should encourage public health officers and researchers to develop CKD prediction models.
- 26 They could conduct new epidemiological studies or leverage on available health surveys with kidney
- 27 biomarkers. These models could have pragmatic and direct applications in clinical medicine, by
- 28 providing a tool for early identification of CKD cases. Similarly, these models could inform public

health interventions and planning, by providing a tool to quantify the size of the population likely to have or to develop CKD.

Clinical guidelines state that CKD is defined as a sustained structural or functional kidney damage for ≥3 months.<sup>31</sup> In the studies herein summarised, CKD was defined at one point in time. Future work could expand the definition of CKD to also incorporate the lapse during which the patient had kidney damage. In addition, different procedures were used to define CKD including eGFR, proteinuria, and UACR. Even amongst those studies in which CKD was defined with eGFR, they used different equations to compute the eGFR. Researchers and practitioners in LMIC could agree on the best and most pragmatic as well as cost-effective definition of CKD, so that future models could use this definition. This would improve the comparability and extrapolability of the models.

All reports in which a new CKD risk score was developed selected the predictors through univariate analyses, <sup>24-27</sup> <sup>29</sup> <sup>30</sup> which is not be the best approach to choose predictors. <sup>32-34</sup> Ideally, predictors should be selected based on expert knowledge, or amongst those with the strongest association evidence with CKD. In a similar vein, predictors selection should be guided by the target population. For example, CKD prediction models for populations in LMIC should prioritize simple biomarkers or inexpensive clinical evaluations (e.g., blood pressure). In this way, the risk score is likely to be used in clinical practice in resource-limited settings. Another relevant methodological limitation was how the original reports handled missing data. To the extent possible, multiple imputation should be implemented to maximize available data and to avoid potential bias by studying only observations with complete information. Finally, calibration metrics need to be consistently reported and should inform the direction of the miscalibration. Most of the studies used the Hosmer-Lemeshow X<sup>2</sup> test as the calibration metric. Unfortunately, this test does not inform on whether the model prediction is overestimating or underestimating the observed risk; calibration plots are a useful alternative.

#### Clinical and public health relevance

The Latin American Society of Nephrology and Hypertension (Sociedad Latinoamericana de Nefrología e Hipertensión - SLANH) recommends to annually screen for CKD with several studies: blood pressure, serum creatinine, proteinuria and urinalysis.<sup>35</sup> The South African Renal Society (SARS) guidelines also recommend CKD screening annually, yet they focus on high-risk populations: people with diabetes, hypertension, or HIV.<sup>36</sup> This recommendation is endorsed by the Asian Forum

This systematic review of diagnostic and prognostic models of CKD did not find conclusive evidence to recommend the use of a single CKD score across LMIC. Nonetheless, we identified relevant efforts in Iran, India, Peru, South Africa, China and Thailand; these models would require further external validation before they can be applied in other LMIC. We encourage researchers and practitioners to develop and validate CKD risk scores, which are cost-efficient tools to early identify CKD prevalent and incident cases so that they can receive timely treatment.

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- already available. All studies analysed for the present review are referenced for readers.

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#### **TABLES:**

#### Table 1. CHARMS criteria to define research question and strategy.

_	
Concept	Criteria
Prognostic or diagnostic?	Both - this review focused on diagnostic and prognostic risk scores for chronic kidney
	disease (CKD)
Scope	Diagnostic/prognostic models to inform physicians, researchers and the general population whether they are likely to have CKD (i.e., diagnostic) or will be likely to have CKD (i.e., prognostic)
Type of prediction modelling studies	<ul> <li>Diagnostic/prognostic models with external validation</li> </ul>
	<ul> <li>Diagnostic/prognostic models without external validation</li> </ul>
	<ul> <li>Diagnostic/prognostic models validation</li> </ul>
Target population to whom the prediction model applies	General adult population in Low- and Middle- Income Countries (LMIC). No age or gender restrictions
Outcome to be predicted	CKD (diagnostic or prognostic)
Time span of prediction	Any, prognostic models will not be included/excluded based on the prediction time span
Intended moment of using the model	Diagnostic/prognostic models to be used in asymptomatic adults of LMIC to ascertain current CKD status or future risk of developing CKD. These models could be used for screening, treatment allocation in primary prevention, or research purposes
Based on the CHARMS checklist. <sup>14</sup>	2

Based on the CHARMS checklist.14

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 Table 2. General characteristics.

5 6 7 8 9 10 11 12 13	Nº of report	Study	Country	Outcome prevalence (%)	Mean age (years	Men (%)	21 on 15 March 2022. Do Erasmusho g for uses related to tex Outcome O	Baselin e sample size	Number of outcome events	Outcome events per candidat e predictor s
14 15 16 17	1	Asgari <i>et al</i> , 2020 European Risk Assessment tool (6- years validation)	Iran	22.08	46.02	40.1	CKD was defined as eGFR <60 mL/mark 1573 m², provided by the MDRD formula oded	3,270	722	n/a
18 19 20 21	1	Asgari <i>et al</i> , 2020 European Risk Assessment tool (9- years validation)	Iran	41.94	NI	40.6	CKD was defined as eGFR <60 mL/ngn/1273 m², provided by the MDRD formula ttp://bi	3,240	1,359	n/a
22 23 24 25 26	2	Bradshaw et al, 2019 - Model 1 (derivation)	India	10.89	44.9	46.8	CKD was defined as an eGFR rate <60∰ml∰min/1.73 m² (estimated with the CKD-EPI equated n) or UACR ≥30 mg/g	8,698	947	31.6
26 27 28 29 30	2	Bradshaw et al, 2019 - Model 2 (derivation)	India	10.89	44.9	46.8	CKD was defined as an eGFR rate <60∰mL8min/1.73 m² (estimated with the CKD-EPI equaten) or UACR ≥30 mg/g	8,698	947	41.2
31 32 33 34	2	Bradshaw <i>et al</i> , 2019 - Model 3a (derivation)	India	10.89	44.9	46.8	CKD was defined as an eGFR rate <60 mL min/1.73 m² (estimated with the CKD-EPI equaten) or UACR ≥30 mg/g	8,698	947	135.3
35 36 37 38	2	Bradshaw <i>et al</i> , 2019 - Model 3b (derivation)	India	10.89	44.9	46.8	CKD was defined as an eGFR rate <60 mL min/1.73 m² (estimated with the CKD-EPI equation) for UACR ≥30 mg/g	8,698	947	118.4
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Bradshaw et al, 2019 - Model

3a (CARRS-I urban

validation)

Bradshaw et al, 2019 - Model

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Bradshaw <i>et al</i> , 2019 - Model 3a (UDAY rural validation)	India	NI	NI	NI	m² (estimated with the CKD-EPI equation) of UACR ≥30 mg/g	4,940	NI	n/a
Carrillo-Larco et al, 2017 - CRONICAS-CKD (derivation complete)	Peru	3.42	57.7	49.4	CKD was defined as eGFR <60 mL/miris 1.73 m², provided by the MDRD form and so are so and so are so and so and so are so	2,368	81	2.25
Carrillo-Larco et al, 2017 - CRONICAS-CKD (derivation lab-free)	Peru	3.42	57.7	49.4	CKD was defined as eGFR <60 mL/mmr21273 m², provided by the MDRD formed from minimum.	2,368	81	3.1
Carrillo-Larco et al, 2017 - CRONICAS-CKD (validation complete)	Peru	5.41	57.1	47.7	CKD was defined as eGFR <60 mL/mm/1273 m², provided by the MDRD formula jo	1,459	79	n/a
Carrillo-Larco et al, 2017 - CRONICAS-CKD (validation lab-free)	Peru	5.41	57.1	47.7	CKD was defined as eGFR <60 mL/man/1973 m², provided by the MDRD formula	1,459	79	n/a
Mogueo <i>et al</i> , 2015 - Korean model (eGFR validation)	South Africa	28.71	55	23.4	CKD was defined as eGFR <60 mL/m²n/1973 m², provided by the 4-variable MDRD formula	902	259	n/a
Mogueo <i>et al</i> , 2015 - Thai model (eGFR validation)	South Africa	28.71	55	23.4	CKD was defined as eGFR <60 mL/nan/1273 m², provided by the 4-variable MDRD for Sula	902	259	n/a
Mogueo <i>et al</i> , 2015 - Korean model (eGFR or proteinuria validation)	South Africa	29.71	55	23.4	CKD was defined as eGFR <60 mL/min/1273 m <sup>2</sup> , provided by the 4-variable MDRD formula and "any nephropathy" (Any of the stages I to V of the KDIGO classification)	902	268	n/a
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m² (estimated with the CKD-EPI equaten) to UACR

≥30 mg/g

CKD was defined as an eGFR rate <60mmLimin/1.73

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4	Mogueo <i>et al</i> , 2015 - Thai model (eGFR or proteinuria validation)	South Africa	29.71	55	23.4	CKD was defined as eGFR <60 mL/ng/n/16/3 m², provided by the 4-variable MDRD formula and "any nephropathy" (Any of the stages I to V of the KDIGO classification)	902	268	n/a
5	Saranburut <i>et al</i> , 2017 - Framingham Heart Study (MDRD validation)	Thailand	10.37	54.6	70.8	CKD was defined as eGFR <60 mL/nan/1273 m², provided by the MDRD form	2,141	222	n/a
5	Saranburut <i>et al</i> , 2017 - Framingham Heart Study (CKD-EPI validation)	Thailand	10.01	54.7	71.5	CKD was defined as eGFR <60 mL/mag 1973 m², provided by the CKD-EPI equations	2,328	233	n/a
6	Saranburut <i>et al</i> , 2017 - Model 1 (derivation Clinical only)	Thailand	8.51	51.3	70.5	CKD was defined as a preserved GFR (EGFR ≥60 mL/min/1.73m²) at baseline and subsequently developed decreased GFR (eGGR <60 mL/min/1.73m²) at the 10 year follow-up provided by the Two-level Race Variable CKD-ER equation (using the non-black coefficient)	3,186	271	18.1
6	Saranburut <i>et al</i> , 2017 - Model 1 BMI (derivation Clinical only)	Thailand	8.51	51.3	70.5	CKD was defined as a preserved GFR (eGFR ≥60 mL/min/1.73m²) at baseline and subsequently developed decreased GFR (eGFR <60 mL/min/1.73m²) at the 10 year follow-up provided by the Two-level Race Variable CKD-E® equation (using the non-black coefficient)	3,186	271	18.1
6	Saranburut <i>et al</i> , 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	Thailand	8.51	51.3	70.5	CKD was defined as a preserved GFI (eGFR ≥60 mL/min/1.73m²) at baseline and subsequently developed decreased GFR (eGFR < €0 mL/min/1.73m²) at the 10 year follow-up, previded by the Two-level Race Variable CKD-EPI equation (using the non-black coefficient)	3,186	271	16.9
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3	6	Saranburut <i>et al</i> , 2017 - Model 3 (derivation Clinical + Full laboratory tests)	Thailand	8.51	51.3	70.5	CKD was defined as a preserved GFF€(eGFR ≥60 mL/min/1.73m²) at baseline and subsequently developed decreased GFR (eGFR <60 mL/min/1.73m²) at the 10 year follow-up previded by the Two-level Race Variable CKD-E® equation (using the non-black coefficient)	3,186	271	12.3
11 12 13 14 15 16 17	6	Saranburut <i>et al</i> , 2017 - Model 1 (validation Clinical only)	Thailand	1.94	45.6	70.5	CKD was defined as a preserved GFR (	1,395	27	n/a
18 19 20 21 22 23 24 25	6	Saranburut <i>et al</i> , 2017 - Model 2 (validation Clinical + Limited laboratory tests)	Thailand	1.94	45.6	70.5	CKD was defined as a preserved GFF (eGFR ≥60 mL/min/1.73m²) at baseline and subsequently developed decreased GFR (eGFR <60 mL/min/1.73m²) at the 10 year follow-ua previded by the Two-level Race Variable CKD-EF equation (using the non-black coefficient)	1,395	27	n/a
26 27 28 29 30 31 32 33 34	7	Thakkinstian <i>et al</i> , 2011 (derivation)	Thailand	18.10	45.2	45.5	CKD was defined as a combination of stages I to V.  CKD stage I & II was defined as eGER ≥90 and eGFR 60-89 ml/min/1.73 m², respectively; with haematuria or UACR ≥30 mg/g. CKD stage III, IV, and V was defined as eGFR 30-59, 15-29, and <15 ml/min/1.73 m², respectively; regardless ockidney damage (eGFR was calculated using the NDRD formula)	3,459	626	16.9
35 36 37 38 39	8	Wen <i>et al</i> , 2020 - Simple Risk Score (derivation)	China	18.06	50	44.7	CKD was defined as an eGFR rate <60 mL min/1.73 m² (assessed with the modified Chinese NDRD equation) or UACR ≥30 mg/g	3,266	590	NI
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1 2								<b>5 2</b>			
3 4 5 6	8	Wen <i>et al</i> , 2020 - Best-fit Risk Score (derivation)	China	18.06	50	44.7	CKD was defined as an eGFR rate <0 m² (assessed with the modified Ch equation) or UACR ≥30 m²	n <b>e</b> se <b>S</b> IDRD	3,266	590	NI
7 8 9	9	Wu <i>et al</i> , 2016 (derivation)	China	2.05	45.3	56.7	CKD was defined as eGFR <60 mL provided by the CKD-EPI eq	0 '	14,374	294	NI
10 — 11 12	9	Wu <i>et al</i> , 2016 (validation)	China	1.10	41.8	63.7	CKD was defined as eGFR <60 mL provided by the CKD-EPI eq	<u>u = 0</u>	4,371	48	n/a
13 └ 14	213	CKD, chronic kidney disease;	CKD-EPI,	chronic kidney	disease e	epidemio	llogy collaboration; eGFR, estimated glo	mier la filtration	n rate; GFR, g	lomerular	
15 16	214	filtration rate; KDIGO, MDRD,	modificatio	n of diet renal	disease;	n/a, not a	applicable; NI, no information; UACR, u	nd <u>೪೭</u> inga ಕ್ಷ್ಮೃತ್ತalbumin-to	o-creatinine ra	itio.	
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#### Table 3. Performance metrics.

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.5 1	Table 3. Performance metrics.		.021-058 , includ
Nº	Study	Discrimination (%)	Chassification measures
1	Asgari <i>et al</i> , 2020 European Risk Assessment tool (6- years validation)	AUC (95% CI) for final intercept adjusted model = Male: 76 (72-79) and Female: 71 (69-73)	For men at a cut-off of 25: sensibility=72.7%; specificity=62.6%. For women at a cut-off of 19: seesibility=66.8%; specificity=65.6%
1	Asgari <i>et al</i> , 2020 European Risk Assessment tool (9- years validation)	AUC (95% CI) for final intercept adjusted model = Male: 71 (67-74) and Female: 70 (68-73)	For men
2	Bradshaw <i>et al</i> , 2019 - Model 1 (derivation)	C-statistic (95% CI) = 79 (78-81)	At a cut-of 0.000 sensibility=72%; specificity=72%; positive predictive value=24%; negative predictive value=96%
2	Bradshaw <i>et al</i> , 2019 - Model 2 (derivation)	C-statistic (95% CI) = 73 (72-75)	At a cut-off of 609: sensibility=68%; specificity=67%; positive predictive value=20%; negative predictive value=95%
2	Bradshaw <i>et al</i> , 2019 - Model 3a (derivation)	C-statistic (95% CI) = 77 (75-79)	At a cut-off of £09: sensibility=71%; specificity=70%; positive predictive value=22%; negative predictive value=95%
2	Bradshaw <i>et al</i> , 2019 - Model 3b (derivation)	C-statistic (95% CI) = 77 (76-79)	At a cut-off 609: sensibility=71%; specificity=70%; positive predictive value=22%; negative predictive value=95%
2	Bradshaw <i>et al</i> , 2019 - Model 3a (CARRS-I urban validation)	C-statistic (95% CI) = 74 (73-74)	yies.
2	Bradshaw <i>et al</i> , 2019 - Model 3a (UDAY rural validation)	C-statistic (95% CI) = 70 (69-71)	partment G
	1		TT 22

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3	Carrillo-Larco <i>et al</i> , 2017 - CRONICAS-CKD (derivation complete)	AUC = 76.2	At a cut-off a sensibility=82.5%; specificity=70.0%; positive pediative value=8.8%; negative predictive value=99.1% likelihood ratio positive=2.8; likelihood ratio negative=0.3
3	Carrillo-Larco <i>et al</i> , 2017 - CRONICAS-CKD (derivation lab-free)	AUC = 76	At a cut-off of 2: sensibility=80%; specificity=72%; positive predictive value=99%; likelihood ratio negative=0.3
3	Carrillo-Larco <i>et al</i> , 2017 - CRONICAS-CKD (validation complete)	AUC = 70	At a cut-offco sensibility=70.5%; specificity=69.1%; positive predictive value=11.4%; negative predictive value=97.6% (a) negative=2.3; likelihood ratio negative=0.4
3	Carrillo-Larco <i>et al</i> , 2017 - CRONICAS-CKD (validation lab-free)	AUC = 70	At a cut-off sensibility=70.5%; specificity=69.7%; positive padictive value=11.6%; negative predictive value=97.7% likelihood ratio positive=2.3; likelihood ratio negative=0.4
4	Mogueo <i>et al</i> , 2015 - Korean model (eGFR validation)	C-statistic (95% CI) = 79.7 (76.5-82.9)	At a cut-off of 8.30: sensibility=82%; specificity=67%
4	Mogueo et al, 2015 - Thai model (eGFR validation)	C-statistic (95% CI) = 76 (72.6-79.3)	At a cut-off 3.31: sensibility=73%; specificity=72%
4	Mogueo <i>et al</i> , 2015 - Korean model (eGFR or proteinuria validation)	C-statistic (95% CI) = 81.1 (78.0-84.2)	At a cut-orgory 31: sensibility=84%; specificity=68%
4	Mogueo <i>et al</i> , 2015 - Thai model (eGFR or proteinuria validation)	C-statistic (95% CI) = 77.2 (73.9-80.5)	At a cut-off of \$\frac{\text{S}}{2}\$32: sensibility=74%; specificity=73%

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5	Saranburut <i>et al</i> , 2017 - Framingham Heart Study (MDRD validation)	AUC (95% CI) = 69 (66-73)	≥1-058921 or including for
5	Saranburut <i>et al</i> , 2017 - Framingham Heart Study (CKD-EPI validation)	AUC (95% CI) = 63 (57-65)	Z 15 March Err
6	Saranburut <i>et al</i> , 2017 - Model 1 (derivation Clinical only)	AUC (95% CI) = 72 (69-75)	≥ 2022. Downloaded tasmushogeschool. ted to text and data
6	Saranburut <i>et al</i> , 2017 - Model 1 BMI (derivation Clinical only)	AUC (95% CI) = 72 (69-75)	Noded from htt
6	Saranburut <i>et al</i> , 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	AUC (95% CI) = 79 (76-82)	From http://bmjopen.bmj.com/ on May 13, mining, Al training, and similar technolog
6	Saranburut <i>et al</i> , 2017 - Model 3 (derivation Clinical + Full laboratory tests)	AUC (95% CI) = 80 (77-82)	en.bmj.com/ g, and simila
6	Saranburut <i>et al</i> , 2017 - Model 1 (validation Clinical only)	AUC (95% CI) = 66 (55-78)	
6	Saranburut <i>et al</i> , 2017 - Model 2 (validation Clinical + Limited laboratory tests)	AUC (95% CI) = 88 (80-95)	Z 2025 at Dep jes.
7	Thakkinstian <i>et al</i> , 2011 (derivation)	C-statistic of internal validation = 74.1	At a cut-off off 5: sensitivity=76%; specificity=69%

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8	Wen <i>et al</i> , 2020 - Simple Risk Score (derivation)	AUC (95% CI) = 71.7 (68.9-74.4)	At a cut-off of 1 sensitivity=70.5%; specific positive pedicave value=29.8%; negative value=91.3%; like in lik	predictive selihood ratio
8	Wen <i>et al</i> , 2020 - Best-fit Risk Score (derivation)	AUC (95% CI) = 72.1 (69.3-74.8)	At a cut-off of 2 sensitivity=56.8%; specific positive page of 2 value=33.8%; negative value=89.4% of 2 negative=0.6	predictive elihood ratio
9	Wu et al, 2016 (derivation)	AUC (95% CI) of internal validation = 89.4 (86.1-92.6)	At a cut-off 6 36: sensitivity=82%; specific	ity=86.3%
9	Wu et al, 2016 (validation)	AUC (95% CI) = 88.0 (82.9-93.1)	nd data	
		nfident interval; NI, no information.	from http://bmjopen.bmj.com/ on May 13, 2025 at Departm mining, Al training, and similar technologies.	

## Table 4: Risk of bias assessment of individual diagnostic/prediction models

Table 4: Risk of bias assessment of indi	vidual diagn	ostic/predicti	BMJ Oper	n		by copyright, includi	36/hm ionen-2021-0580			
			Risk of Bias	(RoB)			plicability		Overall	
Study	Objective	Participants	Predictors	Outcome	Analysi s	Participas ts	<del>.</del>	Outcome	RoB	Applicability
Asgari <i>et al</i> , 2020 European Risk Assessment tool (6-years)	Validation	+	+	?	-	Erasmush related to te +	+ 2022 I	+	-	+
Asgari <i>et al</i> , 2020 European Risk Assessment tool (9-years)	Validation	+	+	?	-	id d	+	+	-	+
Bradshaw et al, 2019 - Model 1	Derivation	Ct.	+	?	-	+ ata m	+ + fr	+	-	+
Bradshaw et al, 2019 - Model 2	Derivation	+	+	?	-	ining,	+	+	-	+
Bradshaw et al, 2019 - Model 3a	Derivation	+	7 to,	?	-	Al tra +	+	+	-	+
Bradshaw et al, 2019 - Model 3b	Derivation	+	+	?	-	ining, +	+	+	-	+
Bradshaw <i>et al</i> , 2019 - Model 3a (CARRS-I urban)	Validation	+	+	?	V_	and sim +	+	+	-	+
Bradshaw et al, 2019 - Model 3a (UDAY rural)	Validation	+	+	?			+ + On Ma	+	-	+
Carrillo-Larco et al, 2017 - CRONICAS- CKD (complete)	Derivation	+	+	+	-	ologies. +	+ + 2025	+	-	+
Carrillo-Larco <i>et al</i> , 2017 - CRONICAS- CKD (lab-free)	Derivation	+	+	+	-	+ 5	ች + Den	+	-	+
Carrillo-Larco et al, 2017 - CRONICAS- CKD (complete)	Validation	+	+	+	-	+	+ + +	+	-	+

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Carrillo-Larco <i>et al</i> , 2017 - CRONICAS- CKD (lab-free)	Validation	+	+	+	-	including +	+ 21-058921	+	-	+
Mogueo <i>et al</i> , 2015 - Korean model (eGFR)	Validation	+	+	?	-	for uses	on 15 M	+	-	+
Mogueo et al, 2015 - Thai model (eGFR)	Validation	+	+	?	-	Era elate +	+	+	-	+
Mogueo <i>et al</i> , 2015 - Korean model (eGFR or proteinuria)	Validation	+	+	?	-	mushog I to text +	+ + 122. Do	+	-	+
Mogueo et al, 2015 - Thai model (eGFR or proteinuria)	Validation	<b>5</b>	+	?	-	ool data	<del>de</del> d	+	-	+
Saranburut <i>et al</i> , 2017 - Framingham Heart Study (MDRD)	Validation	+0	+	?	-	mining, +	from +	+	-	+
Saranburut <i>et al</i> , 2017 - Framingham Heart Study (CKD-EPI)	Validation	+	1 to 1	?	-	Al training, and similar tec	+ +	+	-	+
Saranburut <i>et al</i> , 2017 - Model 1 (Clinical only)	Derivation	+	+	?	1	g, and si +	+ + +	+	-	+
Saranburut <i>et al</i> , 2017 - Model 1 BMI (Clinical only)	Derivation	+	+	?	-C	milar tec +	+ + + + + + + + + + + + + + + + + + +	+	-	+
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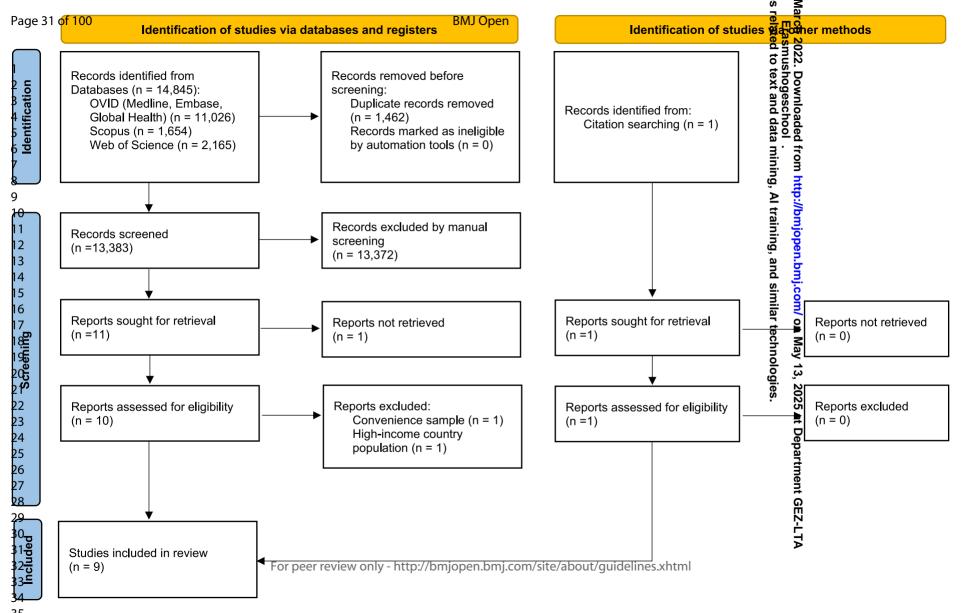
 

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Wu <i>et al</i> , 2016	Validation	+	+	?	-	and d	+	+	-	+

PROBAST = Prediction model Risk of Bias ASsessment Tool;<sup>17</sup> 18 RoB = risk of bias. + indicates low RoB/low conder regarding applicability; - indicates high RoB/high concern regarding applicability; and ? indicates unclear RoB/unclear concern regarding applicability. from http://bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA

Figure 1. PRISMA 2020 flow diagram.





. A systematic review of diagnostic and prognostic models of Chronic kidney disease in Lowand Middle- Income Countries



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#### Chronic Kidney Disease in Low- and Middle- Income Countries: Protocol for a

#### systematic review of diagnostic and prognostic models

Edson J Ascencio<sup>1,2</sup>

Diego J Aparcana-Granda<sup>1,3</sup>

Rodrigo M Carrillo-Larco<sup>3,4</sup>

- 1. Facultad de Medicina Alberto Hurtado, Universidad Peruana Cayetano Heredia, Lima, Perú.
- 2. Emerge, Emerging Diseases and Climate Change Research Unit, School of Public Health and Administration, Universidad Peruana Cayetano Heredia, Lima, Peru
- 3. CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru
- 4. Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK

#### Corresponding author

Rodrigo M Carrillo-Larco, MD

Department of Epidemiology and Biostatistics

School of Public Health, Imperial College London, London W2 1PG, UK

E-mail: rearrill@ic.ac.uk

Phone: +44 0 7578240395

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#### **ABSTRACT**

**Background:** Chronic Kidney Disease (CKD) is a highly prevalent condition with a large disease burden globally. In low- and middle-income countries (LMIC) the CKD screening challenges the health system. This systematic and comprehensive search of all CKD diagnostic and prognostic models in LMIC will inform screening strategies in LMIC following a risk-based approach.

**Objective:** To summarize all multivariate diagnostic and prognostic models for CKD in adults in LMIC.

**Methods:** Systematic review. Without date or language restrictions we will search Embase, Medline, Global Health (these three through Ovid), SCOPUS and Web of Science. We seek multivariable diagnostic or prognostic models which included a random sample of the general population. We will screen titles and abstracts; we will then study the selected reports. Both phases will be done by two reviewers independently. Data extraction will be performed by two researchers independently using a pre-specified Excel form (CHARMS model). We will evaluate the risk of bias with the PROBAST tool.

**Conclusion:** This systematic review will provide the most comprehensive list and critical appraisal of diagnostic and prognostic models for CKD available for the general population in LMIC. This evidence could

 inform policies and interventions to improve CKD screening in LMIC following a risk-based approach, maximizing limited resources and reaching populations with limited access to CKD screening tests. This systematic review will also reveal methodological limitations and research needs to improve CKD diagnostic and prognostic models in LMIC.

**Keywords:** Chronic Kidney Disease; Diagnostic Models; Prognostic Models; Low- and Middle-income countries.

#### INTRODUCTION

Chronic kidney disease (CKD) is a highly prevalent condition that contributes to a large part of disease burden globally. Between 1990 and 2017, the health metrics of CKD showed a bleak profile: mortality rate, incidence and kidney transplantation rate increased by 2.8%, 29.3% and 34.4%, respectively. CKD led to 1.2 million deaths in 2017 and in the best-case scenario, mortality is projected to increase to 2.2 million deaths<sup>2</sup> and become the 5th cause of years of life lost (YLL) by 2040. Currently, 2.5 million of patients receive kidney transplantation therapy and it is projected to increase to 5.4 million by 2030. CKD also reveals disparities between low- and middle-income countries (LMIC) and high income countries (HIC); for example, the age-standardised disability-adjusted life-year (DALY) rate due to CKD was the highest in LMIC between 1990-2017. In LMIC, that remain as resource-constrained settings, there is a need for optimization of the CKD screening strategies which usually challenge the health system.

Risk equations or risk scores are a cost-effective alternative for CKD screening.<sup>6</sup> These equations are less invasive and accepted by the general population;<sup>7</sup> also, they require less resources like laboratory tests.<sup>8</sup> Many scores were developed in high-income countries,<sup>9-11</sup> and they may not be used in LMIC because their accuracy is better where they have been developed.<sup>12</sup> Current strategies for CKD screening suggest studying people with risk factors (e.g. diabetes, hypertension).<sup>13-15</sup> These recommendations rely on studies where albuminuria and proteinuria were used as screening tools for identifying CKD patients.<sup>16</sup> Nevertheless, a systematic review found that using risk scores allows screening of a larger population and therefore can be useful for detecting more CKD cases.<sup>6</sup>

To date, there are no systematic reviews of diagnostic or prognostic models for CKD with a focus on LMIC.<sup>17, 18</sup> This limits our knowledge of what tools we have to enhance CKD screening in LMIC; similarly, this dearth of evidence prevents from planning future research to overcome the limitations of available models. This will be the first systematic review to fill these knowledge gaps in LMIC to improve and complement the CKD screening programmes in LMIC.

#### **METHODS**

#### **Objective**

To synthesise CKD diagnostic and prognostic models for the adult population of LMIC.

### Study design

This systematic review and meta-analysis will be conducted following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines.<sup>19</sup> We will also adhere to the recommendations for systematic reviews of diagnostic and prognostic models following the CHARMS guidelines<sup>20</sup> and the PROBAST tool to assess risk of bias.<sup>21</sup>

#### Eligibility criteria

*Participants/population:* We will include the general adult population (18 years and above) of LMIC with no gender restrictions. Studies following a population-based random sampling approach will be included. We will only include populations from LMIC according to The World Bank.<sup>22</sup> Conversely, studies with a study population of only patients (e.g., people with hypertension) or high-risk individuals (e.g., smokers) will be excluded. We will exclude studies with LMIC populations outside a LMIC.

Intervention, exposure: None (this review is looking at CKD diagnostic and prognostic models in LMIC).

Comparator, control: None (this review is looking at CKD diagnostic and prognostic models in LMIC).

Outcome: Diagnostic and prognostic models for CKD. The CKD diagnosis should have been based on a laboratory or imaging test including: urine albumin- creatinine ratio, urine protein-creatinine ratio, albumin excretion ratio, urine sediment, kidney images, kidney biopsy or the estimated glomerular filtration rate (eGFR). In other words, research in which CKD diagnosis was based on self-reported information only will not be considered. However, if a study combined both self-reported information and a laboratory or imaging tests, this will be included.

*Types of studies:* Studies with an observational design will be included, which encompasses crosssectional (for diagnostic models) and prospective longitudinal studies (for prognostic models). If we retrieve any systematic review on this subject, we will revise its reference list to identify relevant original sources.

#### Literature Search and Data collation

The search will be conducted in five search engines: Embase, Medline, Global Health (these three through Ovid), SCOPUS and Web of Science. No date or language restrictions will be set. The complete search strategy can be found in Supplementary Material.

Titles and abstracts will be screened by two researchers independently (DJA-G and EJA), looking for studies that meet the selection criteria above detailed. Full-text reports of the selected publications will be studied by two researchers independently (DJA-G and EJA). Discrepancies at any stage will be solved by consensus or by a third party (RMC-L).

During the full-text phase, if there are any original reports in which the population, methodology or results are not clear enough to assess the inclusion/exclusion criteria, we will contact the corresponding author by email. We will wait for two weeks, if we receive no answer and cannot solve our doubts through other means, this report will be excluded based on the lack of clarity to assess inclusion/exclusion criteria.

We will record the reasons for exclusion in the full-text phase and summarize the number of included/excluded reports following the PRISMA flow diagram.

## **Data extraction**

 We will develop a data extraction form following the CHARMS recommendations.<sup>20</sup> Data extraction will be conducted by two researchers independently; discrepancies will be solved by consensus or by a third party (RMC-L).

# Risk of bias of individual studies

The risk of bias assessment of individual reports will be conducted using the Prediction model Risk Of

Bias ASsessment Tool (PROBAST) tool.<sup>21</sup>

#### **Statistical Analysis**

A qualitative synthesis is planned, whereby we will narratively synthesise the findings from the selected studies. We will summarize the key elements from each report such as study design, study population and characteristics of the study population. Also, we will summarize the key features of the risk scores as provided by each report, including discrimination, calibration, sensitivity, specificity, and predictive values. A quantitative synthesis will be carried out if the included studies are found to be sufficiently homogenous and we have at least four original reports.

#### **Ethics**

This review did not directly include human subjects. We considered this work as 'low risk' and did not request approval by an Ethics Committee. Results and opinions included in this protocol, and those included in the final report, are the author's alone and do not represent those of the institutions to which they belong.

 This systematic review will provide a comprehensive list of diagnostic and prognostic models for CKD for people in LMIC, along with their accuracy metrics. Currently, information lacks in LMIC where diagnostic and prognostic models could inform CKD screening strategies. Similarly, this work will elucidate the limitations of available diagnostic and prognostic models for CKD in LMIC, so that future research can be planned accordingly to overcome these caveats and deliver robust models to advance

CKD screening strategies in LMIC.

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Section and Topic	Item #	Checklist item  Checklist item  Era  Era	Location where item is reported
TITLE		2022. Do	
Title	1	Identify the report as a systematic review.	page 01
ABSTRACT		ta mini	
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	page 02
INTRODUCTION	·	ining,	
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	page 03
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	page 04
METHODS		ologies	
Eligibility criteria	5	· iò	page 04-05
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources search or consulted to identify studies. Specify the date when each source was last searched or source was last searched or source.	
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Search strategy	7	Present the full search strategies for all databases, registers and websites, including any there and limits used.	supplementary page 03-07
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	page 05
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collect data from each report, whether they worked independently, any processes for obtaining or complete from study investigators, and if applicable, details of automation tools used in the processes and if applicable, details of automation tools used in the processes.	page 05-06
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results the compatible with each outcome domain in each study were sought (e.g. for all measures, the points, analyses), and if not, the methods used to decide which results to collect.	page 04-05, table 1
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing information.	page 04-05, table 1
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently and if applicable, details of automation tools used in the process.	page 06
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	NA
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	page 06
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	NA
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	page 06

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	13d	Describe any methods used to synthesize results and provide a rationale for the choice (statistical heterogeneity, and software package(s) used.	page 06
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	NA
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized கூயிர்க்க	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthes estimated by the properties of the	NA
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	page 11
RESULTS		Al train	
Study selection	16a	Describe the results of the search and selection process, from the number of records in the search to the number of studies included in the review, ideally using a flow diagram.	page 06-07
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded why they were excluded.	page 06-07
Study characteristics	17	Cite each included study and present its characteristics.  Chnologies 13, 20	page 08-09
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	page 11, supplementary page 39-45

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Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where aboropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally structured tables or plots.	page 9-11
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among cont <b>b</b> bu <b>a</b> g studies.	page 9-11
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present the summary estimate and its precision (e.g. confidence/credible interval) and measures heterogeneity. If comparing groups, describe the direction of the effect.	table 3
	20c	Present results of all investigations of possible causes of heterogeneity among study established.	NA
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the sent results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each out assessed.	page 11
DISCUSSION	•	hilar te	
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.  Nay 13, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20	page 11
	23b	Discuss any limitations of the evidence included in the review.	page 11-13
	23c	Discuss any limitations of the review processes used.	page 11-13
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	23d		page 14-15
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Registration and protocol	24a	Provide registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review, including register name and registration information for the review including register name and registration information for the review including register name and registration in the review was not registered.	page 04
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not be accessed.	page 04
	24c	Describe and explain any amendments to information provided at registration or in the Bacocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	page 01
Competing interests	26	Declare any competing interests of review authors.	page 01
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	page 15
NA: Not applicable		n May 13, 202 echnologies	
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# S2.1 Table: Embase, Medline and Global Health (OVID)

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33	risk equation\$.mp.
34	risk table\$.mp.
35	risk threshold\$.mp.
36	risk disc?.mp.
37	risk disk?.mp.
38	risk scoring method?.mp.
39	scoring scheme?.mp.
40	risk scoring system?.mp.
41	risk scal\$.mp.
42	risk prediction?.mp.
43	risk algorith\$.mp.
44	prediction model\$.mp.
45	predictive instrument?.mp.
46	project\$ risk?.mp.
47	predictive model?.mp.
48	scoring method\$.mp.
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#### S2.2 Table: SCOPUS

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### **S2.3 Table: WEB OF SCIENCE**

(((chronic renal insufficiency) OR (chronic kidney disease) OR (chronic kidney failure) OR (CKD) OR (Renal Insufficiency, Chronic) OR (chronic NEAR/2 kidney NEAR/2 disease) OR (chronic NEAR/2 kidney NEAR/2 failure) OR (chronic renal failure) OR (chronic renal disease) OR (chronic kidney insufficiency) OR (end stage renal disease) OR (ESRD) OR (kidney function) OR (renal function) OR (kidney dysfunction) OR (renal dysfunction)) AND (("Afghanistan") OR ("Benin") OR ("Burkina Faso") OR ("Burundi") OR ("Central African Republic") OR ("Chad") OR ("Comoros") OR ("Democratic Republic of the Congo") OR ("Eritrea") OR ("Ethiopia") OR ("Gambia") OR ("Guinea") OR ("Guinea-Bissau") OR ("Haiti") OR ("Democratic People's Republic of Korea") OR ("Liberia") OR ("Madagascar") OR ("Malawi") OR ("Mali") OR ("Mozambique") OR ("Nepal") OR ("Niger") OR ("Rwanda") OR ("Senegal") OR ("Sierra Leone") OR ("Somalia") OR ("South Sudan") OR ("Tanzania") OR ("Togo") OR ("Uganda") OR ("Zimbabwe") OR ("Armenia") OR ("Bangladesh") OR ("Bhutan") OR ("Bolivia") OR ("Cape Verde") OR ("Cambodia") OR ("Cameroon") OR ("Congo") OR ("Cote d'Ivoire") OR ("Djibouti") OR ("Egypt") OR ("El Salvador") OR ("Ghana") OR ("Guatemala") OR ("Honduras") OR ("India") OR ("Indonesia") OR ("Kenya") OR ("Micronesia") OR ("Kosovo") OR ("Kyrgyzstan") OR ("Laos") OR ("Lesotho") OR ("Mauritania") OR ("Moldova") OR ("Mongolia") OR ("Morocco") ÓR ("Myanmar") OR ("Nicaragua") OR ("Nigeria") OR ("Pakistan") OR ("Papua New Guinea") OR ("Philippines") OR ("Samoa") OR ("Atlantic Islands") OR ("Melanesia") OR ("Sri Lanka") OR ("Sudan") OR ("Swaziland") OR ("Syria") OR ("Tajikistan") OR ("Timor-Leste") OR ("Tonga") OR ("Tunisia") OR ("Ukraine") OR ("Uzbekistan") OR ("Vanuatu") OR ("Vietnam") OR ("Middle East") OR "Yemen") OR ("Zambia") OR ("Albania") OR ("Algeria") OR ("American Samoa") OR ("Angola") OR ("Argentina") OR ("Azerbaijan") OR ("Republic of Belarus") OR ("Belize") OR ("Bosnia and Herzegovina") OR ("Botswana") OR ("Brazil") OR ("Bulgaria") OR ("China") OR ("Colombia") OR ("Costa Rica") OR ("Cuba") OR ("Dominica") OR ("Dominican Republic") OR ("Equatorial Guinea") OR ("Ecuador") OR ("Fiji") OR ("Gabon") OR ("Georgia") OR ("Grenada") OR ("Guyana") OR ("Iran") OR ("Iraq") OR ("Jamaica") OR ("Jordan") OR ("Kazakhstan") OR ("Lebanon") OR ("Libya") OR ("Macedonia (Republic) ") OR ("Malaysia") OR ("Indian Ocean Islands") OR ("Mexico") OR ("Montenegro") OR ("Namibia") OR ("Palau") OR ("Panama") OR ("Paraguay") OR ("Peru") OR ("Russia") OR ("Serbia") OR ("South Africa") OR ("Saint Lucia") OR ("Saint Vincent and the Grenadines") OR ("Suriname") OR ("Thailand") OR ("Turkey") OR ("Turkmenistan") OR ("Venezuela") OR (developing countr) OR (lowincome countr\*) OR (middle-income countr\*) OR (lowmiddle income countr\*) OR (upper-middle income countr\*)) AND ((risk assessment) OR (risk equation\$) OR (risk chart?) OR (risk NEAR/3 tool\$) OR (risk assessment function?) OR (risk assessor) OR (risk appraisal\$) OR (risk calculation\$) OR (risk calculator\$) OR (risk factor\$ calculation\$) OR (risk engine\$) OR (risk equation\$) OR (risk table\$) OR (risk threshold\$) OR (risk disc?) OR (risk disk?) OR (risk scoring method?) OR (scoring scheme?) OR (risk scoring system?) OR (risk scal\$) OR (risk prediction?) OR (risk algorith\$) OR (prediction model\$) OR (predictive instrument?) OR (project\$ risk?) OR (predictive model?) OR (scoring method\$) OR (prediction\$ NEAR/3 method\$) OR (risk? NEAR/1 assess\$) OR (screening) OR (diagnostic test))) NOT ((animal\*) OR ("not humans"))

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 S3 Table: Data extraction form (by chapters)
S3.1 Table: Source of data and participants

		Sour ce of data		/			S related to te					
N°	Study	Sour ce of data	Partici pant locati on	Ba sel in e ye ar	En d ye ar (c oh ort s)	Sam pling	Inclusion criteria	ar tec	co m e pr e al en ce (%)	Outc ome incid ence (for coho rts)	Baseli ne mean age	Baselin e % men
1	Asgari, 2020 Europea n Risk Assess ment tool (6- years validatio	Cohort	Communit		2011	Pandom	Tehran lipids and glucose study (TLGS) cohort	(CVD), Type 2 Diabet Mellitus or End-stage Renal Disease with (eGFR) <15 mL/min/1.73 m2. Also excluded those with missing data at baseline for creatinine (Cr), fasting plasma glucose (FPG), 2-	46.02 (11.95	40.19/	E9 24	20 52
_ 1	n)	Cohort	ј у	2005	2011	Random	participants.	hour postchallenge plasma	<del>(</del> )	40.1%	58.34	29.53

of ´	100							BMJ Open	d by copyright,	36/hm ionen-202			
_									<del> </del>	en-2024			
									smoking status as wells s participants with missing data during follow-up on Cr, FPG, 2 h-PCG and CVD status				
		Asgari, 2020 Europea n Risk Assess ment tool (9- years validatio		Communit	1999-	2009-	D6	Tehran lipids and glucose study (TLGS) cohort	Persons with prevalent Cardiovascular Disease (CVD), Type 2 Diabetes Disease with (eGFR) Sease with (eGFR) Sease with (eGFR) Sease with (eGFR) Sease with missing data at baseline forming creatinine (Cr), fasting plasma glucose (FPG), 2-hour postchallenge plasma glucose (2 h-PCG), body mass index (BMI), wast circumference (WC) and smoking status as well as participants with missing data during follow-up or Cr, FPG, 2 h-PCG and C	Downloaded from http://bmionen.hmi			
	1	n) Bradsha w, 2019 - Model	Cohort	у	2005	2018	Random	participants.  Any individual aged ≥20 years and permanently residingin at Delhi and Chennai (CARRS-II). A permanent resident was defined as a person living in the selected household, was related to the	status  Technologies  Beddriden individuals,  pregnant women,  participants with missing  both or either serum	Z May 13 2025 at Dans	40.6%	48.20	49.70
	2	1 (derivati on)	Cross- sectional	Communit y	2015	n/a	Random	household head and ate at least 3 meals in a week with the family.	•		46.8%	48.20	49.70

	- Model 3a (derivati on)	Cross- sectional	Communit	2015	n/a		Chennai (CARRS-II). A permanent resident was defined as a person living in the selected household,	both or either serum creatinine or urine albumin- to- creatinine ratio data and		46.8%	39.90	46.97
	Bradsha w, 2019						Any individual aged ≥20 years and permanently residingin at Delhi and	Beddriden individuals, pregnant women, participants with missing	35 24 7			
2	(derivati on)	Cross- sectional	Communit y	2015	n/a	Random	migratedpermanently or are considered visitors"	to- creatinine ratio data <b>a</b> nd <b>b</b> participants on dialysi <b>s</b> :	\$ 44.9	46.8%	48.20	49.70
	- Model 2						home. This does not include people who have	both or either serung creatinine or urine alburgin				
	Bradsha w, 2019						atleast one meal together a day when they are at	pregnant women, 🚉 participants with missing				
							wholive together, usually pool their income and eat	Beddriden individuals				
							as "a group of people	mining, Al training, and				
							Households were defined	ng,				
							with the family.	ini				
							at least 3 meals in a week	tra				
							household head and ate	, <u>A</u>				
							in the selected household, was related to the	ing .				
							defined as a person living	nini. di				
						(	permanent resident was	2 – q	<u>.</u>			
							Chennai (CARRS-II). A	inclade ind dat	5			
							residingin at Delhi and	nd sch	{			
							years and permanently	hoge: lext a				
							Any individual aged ≥20					
							are considered visitors"	opyright, including for uses related to	ง ง			
							migratedpermanently or	ted	3			
							include people who have	ela Er	5			
							a day when they are at home. This does not	opyright, including for uses related				
							atleast one meal together	l sen	n Y			
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			1				Households were defined	= 9	2			

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	3a						(CARRS-I). A permanent	both or either serum ੇ ਵੀ	2			
	(CARRS						resident was defined as a	creatinine or urine albur <del></del> in-	ġ			
	-l urban						person living in the	to- creatinine ratio data <b>ផ</b> nd <b>់</b>	2			
	validatio						selected household, was	participants on dialysi <b>g</b> . 9	)			
	n)						related to the household	· _ · _ · ·	_			
	,						head and ate at least 3	ses <del>V</del>	1			
							meals in a week with the	i re				
							family. Households were	lat	}			
							defined as "a group of	ed ed	3			
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							and eat atleast one meal	ct a				
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							are at home. This does	da da	<u></u>			
							not include people who	nta	_			
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							10.	Participants with missing				
								both or either serum <u>ត</u> ្តិ				
							UDAY cohort participants	creatinine or urine alburain-	-			
	Bradsha						((a) adults aged ≥30 years	াto- creatinine ratio da <b>র্ট্র</b> ,				
	w, 2019						residing in the sampled	unwilling to provide≌				
	- Model						urban and rural areas of	informed consent, wit				
	3a						Sonipat and Vizag,	serious chronic illness <b>e</b> s				
	(UDAY						respectively; and (b)	[such as that of the liver				
	rural						willing to participate and	(cirrhosis), kidneys (renal	}			
	validatio	Cross-	Communit				provide informed	failure) or malignancieឡី, 🛓	5			
2	n)	sectional	У	2014	n/a	Random	consent).	and pregnant women 3	NI	NI	47.20	38.00
								Being pregnant, having	5			
	Carrillo-							Being pregnant, having 3 active pulmonary 6 tuberculosis, and having	3			
	Larco,								) 1			
	2017 -							any disability preventing 🙎	1			
	CRONI							from undergoing	7			
	CAS-						Full time resident, capable	anthropometric g				
	CKD	_					of giving informed	assessments, having CKD,				
	(derivati	Cross-	Communit	2013-	_	_	consent, one subject per	missing values in the	57.7			
3	on	sectional	У	2014	n/a	Random	household.	prediction variables, missing	(12.4)	49.4%		
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of 100							BMJ Open	d by copyright, i	36/hm ion		
		1						<u> </u>			
	complet e)							values in key variables o g calculate eGFR, subjects with BMI >40 kg/m2 or MINI >40 kg/m2.	050001 00		
3	Carrillo- Larco, 2017 - CRONI CAS- CKD (derivati on lab- free)	Cross- sectional	Communit	2013- 2014	n/a	Random	Full time resident, capable of giving informed consent, one subject per household.	Being pregnant, having active pulmonary stuberculosis, and having any disability preventing any		49.4%	
3	Carrillo- Larco, 2017 - CRONI CAS- CKD (validati on complet e)	Cross-sectional	Communit	2004- 2006	n/a	Random	PREVENCION cohort participants.	Report having CKD, missing values in key variables o calculate eGFR, subjects with BMI >40 kg/m2 or MI <18.5 kg/m2, age < 35 years, missing values in Albarrage   18.5 kg/m2 values in Albarrage   18.	///	47.7%	
3	Carrillo- Larco, 2017 - CRONI CAS- CKD (validati on lab- free)	Cross- sectional	Communit	2004- 2006	n/a	Random	PREVENCION cohort participants.	Report having CKD, misging values in key variables o calculate eGFR, subjects with BMI >40 kg/m2 or BMI <18.5 kg/m2, age < 35 years, missing values in prediction variables.	57.1 (12.6)	47.7%	
4	Mogueo , 2015 -	Cross- sectional	Communit y	2008- 2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missing data on all variables, except	55 (15)	23.4%	

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	Korean model (eGFR validatio n)							ht, including for uses related ana			
4	Mogueo , 2015 - Thai model (eGFR validatio n)	Cross- sectional	Communit y	2008- 2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missing the data on all variables, execution kidney stones	(15)	23.4%	
4	Mogueo , 2015 - Korean model (eGFR or proteinu ria validatio n)	Cross- sectional	Communit	2008- 2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missing data on all variables, execution	55	23.4%	
4	Mogueo , 2015 - Thai model (eGFR or proteinu ria validatio n)	Cross- sectional	Communit y	2008-2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missigg data on all variables, exeeptooks		23.4%	
5	Saranbu rut, 2017 - Framing ham Heart	Cohort	Communit y	2002	2012	Random	Employees of the Electric Generating Authority of Thailand (EGAT) who participated in a health survey in 2002	Subjects who had CKD at baseline or did not have serum creatinine at baseline or at follow-up.		70.8%	
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who died, retired and

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60) at baseline in 2009

(EGAT 3 1st examination)

who were followed up 5

vears later in 2014 (EGAT

3 2nd examination).

of 100							BMJ Open	by copyright, including	36/bm jopen-2021 <del>-058921</del>		
	Limited laborato ry tests)							including	21 <del>-058921</del>		
7	Thakkin stian, 2011 (derivati on)	Cross- sectional	Communit y	2007- 2008	n/a	Random	Global Screening and Early Evaluation of Kidney Disease (SEEK) study subjects: being 18 years or older, had no menstruation period for at least a week prior to the examination date if women, and whom were willing participants of the study and provided signed consent forms.	Erasmushogeschoo for uses related to text and da and da Subjects without blood	on 15 March 2022. Downlo	45.5%	
8	Wen, 2020 - Simple Risk Score (derivati on)	Cohort	Communit	2006- 2007	2012- 2013	Random	Handan Eye Study (HES) participants (rural residents aged ≥30 years old living in Yongnian County).	Subjects who were, diagnosed with CKD unwilling to participate missing follow up date (eGFR or UACR).	from http://bmiope. 50 (10)	44.7%	
8	Wen, 2020 - Best-fit Risk Score (derivati on)	Cohort	Communit	2006- 2007	2012- 2013	Random	Handan Eye Study (HES) participants (rural residents aged ≥30 years old living in Yongnian County).	Subjects who were midiagnosed with CKD are unwilling to participate missing follow up data (eGFR or UACR).	50 (10)	44.7%	
9	Wu, 2016 (derivati on)	Cross- sectional	Communit y	2012	n/a	Random	Adults older than 18 years and having given consent to this study.	Participants without: age information; body mags index (BMI) information; blood pressure (BP) measurement; serum	13. 2025 at Depa (14.3)	56.7%	
9	Wu, 2016	Cross- sectional	Communit y	2012	n/a	Random	Adults older than 18 years and having given consent to this study.	Participants without: age information; body mass index (BMI) information;	41.8 6 (11.7) E C	63.7%	

53.2	ı abie::	Outcome

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S3.	2 Table:: Outcom	e		by copyright, including for uses re			
			Outcome	uses r	1		
N°	Study	Outcome	Outcome details	Same outcome telision data minir	T	Predictor s part of the outcome	Mean follow- up (years) (cohorts )
1	Asgari, 2020 European Risk Assessment tool (6-years validation)	CKD composite	CKD was defined as eGFR < 60 mL/min/1.73 m2, provided by the Modification of Diet in Renal Disease (MDRD).	data mining, / Yes	NI	No	6.2
1	Asgari, 2020 European Risk Assessment tool (9-years validation)	CKD composite	CKD was defined as eGFR < 60 mL/min/1.73 m2, provided by the Modification of Diet in Renal Disease (MDRD).	VI training, and	NI	No	9.2
2	Bradshaw, 2019 - Model 1 (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes similar	NI	No	0
2	Bradshaw, 2019 - Model 2 (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	technologies Yes		No	0
2	Bradshaw, 2019 - Model 3a (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	ogies. Yes	NI	No	0
2	Bradshaw, 2019 - Model 3b (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes		No	0
2	Bradshaw, 2019 - Model 3a	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes		No	0

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	(CARRS-I urban			)ht, inclu	  -2021 <u>-</u> 0589		
	validation)			ig:	58 <u>0</u>		
	Bradshaw, 2019			9	2		
	- Model 3a			for	<u>0</u>		
	(UDAY rural	CKD	CKD was defined as an eGFR rate <60 mL/min/1.73 m2	us	5		
2	validation)	composite	(estimated by the CKD-EPI equation) or UACR ≥30 mg/g		5 NI	No	0
3	Carrillo-Larco, 2017 - CRONICAS- CKD (derivation complete)	CKD composite	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also known as CKD stage III	Erasmusho related to tex s es Y	arch 2022. Do	No	0
	Carrillo-Larco, 2017 - CRONICAS- CKD (derivation	CKD	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also	eschool and data	wnloaded f		
3	lab-free)	composite	known as CKD stage III	Yes 🚆	<u>6</u> Yes	No	0
3	Carrillo-Larco, 2017 - CRONICAS- CKD (validation complete)	CKD composite	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also known as CKD stage III	Yes	n http://bmjo	No	0
3	Carrillo-Larco, 2017 - CRONICAS- CKD (validation lab-free)	CKD composite	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also known as CKD stage III	g, and similar	bn bn com	No	0
4	Mogueo, 2015 - Korean model (eGFR validation)	CKD composite	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula	Yes	on May 13.	No	0
4	Mogueo, 2015 - Thai model (eGFR validation)	CKD composite	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula	-	\(\overline{Z}\) 2025 at De	No	0
	Mogueo, 2015 - Korean model	CKD	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula and 'any nephropathy' including any of the stages I to V of the	-	partment GE		
4	(eGFR or	composite	Kidney Disease: Improving Global Outcomes Chronic	Yes	<u>ត</u> NI	No	0

00			BMJ Open	d by copyright, includi	36/bmjopen-		
	proteinuria validation)		Kidney Disease (KDIGO) classification	ıt, includi	-2021 <u>-058</u> 9		
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	CKD composite	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula and 'any nephropathy' including any of the stages I to V of the Kidney Disease: Improving Global Outcomes Chronic Kidney Disease (KDIGO) classification	ng for uses re	Z 21 on 15 Mar	No	0
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	CKD composite	CKD was defined as estimate glomerular filtration rate (eGFR) <60 mL/min/1.73 m2 using the Modification of Diet in Renal Disease (MDRD)	ated to text and Yes	Do	No	10
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	CKD composite	CKD defined as (eGFR) <60 mL/min/1.73 m2 using the CKD-EPI equation.	data mining, AI. Yes	Z	No	10
6	Saranburut, 2017 - Model 1 (derivation Clinical only)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	training, and simila	Z z	No	10
6	Saranburut, 2017 - Model 1 BMI (derivation	CKD	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	r technologies.	= = = = = = = = = = = = = = = = = = =	No	10
	Clinical only) Saranburut, 2017 - Model 2 (derivation Clinical + Limited	composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology		Departmen		
6	laboratory tests)	composite	Collaboration (CKDEPI) equation using the non-black	Yes	E NI	No	10

			BMJ Open	ייין אין ניסף אוויין	36/bmjopen-202			ı
			coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	9	)21 <u>-0589</u>			
6	Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	Yes	21 on 15 March 20: Erasn	NI	No	10
6	Saranburut, 2017 - Model 1 (validation Clinical only)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5			NI	No	5
6	Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	Yes	h://bmjope	NI	No	5
7	Thakkinstian, 2011 (derivation)	CKD composite	CKD was defined as stage I & II if GFR ≥ 90 and GFR 60-89 ml/min/1.73 m2 with haematuria and/or albumin-creatinine ratio 30 mg/g or greater, stage III, IV, and V if the GFR of 30-59, 15-29, and < 15 ml/min/1.73 m2 respectively, regardless of kidney damage. eGFR was calculated using the MDRD equation for IDMS traceable serum creatinine values.	Yes Yes	omj.com/ on May 13,	NI	No	0
8	Wen, 2020 - Simple Risk Score (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 ((assessed by the modified Chinese MDRD equation) or UACR ≥30 mg/g	Yes		NI	No	5.6
8	Wen, 2020 - Best-fit Risk Score (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 ((assessed by the modified Chinese MDRD equation) or UACR ≥30 mg/g	Yes	partment GEZ-	NI	No	5.6

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					5 2	2		
	Wu, 2016	CKD	Reduced eGFR was defined as eGFR<60 mL/min/1.73 m2		includima	2		
9	(derivation)	composite	using the CKD-EPI equation.	Yes	di ğ	Š NI	No	0
	Wu, 2016	CKD	Reduced eGFR was defined as eGFR<60 mL/min/1.73 m2	٥	<u> </u>	2		
9	(validation)	composite	using the CKD-EPI equation.	Yes	for g	NI NI	No	0
or diet itel	nai disease, II/a, IIOL e	applicable, NI, IIO III	Reduced eGFR was defined as eGFR<60 mL/min/1.73 m2 using the CKD-EPI equation.  idney disease epidemiology collaboration; eGFR, estimated glomerular filtral formation; UACR, urinary albumin-to-creatinine ratio.	uidelines.xhtml	warch בעבב. Downloaded from http://bmjopen.bmj.com/ on way יוש, בעבים מני Department Gez-LIA Erasmushogeschool . srelated to text and data mining. Al training, and similar technologies.			3

# S3.3 Table: Candidate predictors

					В	MJ Open	d by copyri	36/bm jope	Pa
S	3.3 Table: 0	Candidat	e predicto	rs				36/bmjopen-2021-0589 <u>2</u> 1 on	
N°	Study	Nu mb er of can did ate pre dict ors	Num ber of predi ctors in the final mod el	Predi ctors timing	List of predictors in the final model		Era uses relat	n 15 March 2027 redictors ascertainment  Downloade	Predictors modelling
1	Asgari, 2020 European Risk Assessme nt tool (6- years validation)	n/a	18	NI	Age; BMI (body mass index); waist circumference; use of antihypertensives; current smoking, parent and/or sibling with myocardial infarction or stroke; parent and/or sibling with diabetes.	Age (<45, ≥45 to <50, ≥50 to <55, ≥55 to <60, ≥60 to <65, ≥65 to <70, ≥70 to <75, ≥75 to <85); Body mass index (<25, ≥25 to <30, ≥30); Waist circumference [<94, ≥94 to <102, ≥102 (for men) and <80, ≥80 to <88, ≥88 (for women)]; use of antihypertensive medications; current smoking ('who smokes cigarettes daily or occasionally'); family history of cardiovascular disease (CVD) and/or diabetes (previously diagnosed CVD in first-degree male and female relatives aged < 55 and < 65 years, respectively)	niging. Al training, and similar technoli	Data collected by trained erviewer using a standard questionnaire	n/a
1	Asgari, 2020 European Risk Assessme nt tool (9- years validation)	n/a	18	NI	Age; BMI (body mass index); waist circumference; use of antihypertensives; current smoking, parent and/or sibling with myocardial infarction or stroke; parent and/or sibling with diabetes.	Age (<45, ≥45 to <50, ≥50 to <55, ≥55 to <60, ≥60 to <65, ≥65 to <70, ≥70 to <75, ≥75 to <85); Body mass index (<25, ≥25 to <30, ≥30); Waist circumference [<94, ≥94 to <102, ≥102 (for men) and <80, ≥80 to <88, ≥88 (for women)]; use of antihypertensive medications; current smoking ('who smokes cigarettes daily	Bt (I	was calculated as weight by divided by height (m2). Data collected by trained erviewer using a standard questionnaire	n/a

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						njopen-2021-058921 on 15 March Era opyright, including for uses relat		distribution categorical variable were summarizal using percentage and cour
Bradshaw, 2019 -				)r Deer	evien o	njopen-2021-058921 on 15 March 2022. Downloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Department Erasmushogeschool . opyright, including for uses related to text and data mining, Altraining, and similar technologies.		All continuo variable used cut spline ter with kno placed a fixed quantiles the predicto margina distributic categoric variable were summariz
Model 3a (derivation )	NI	NI	NI	NI	NI	v on Ma	NI	using percenta and cour
						ay 13, 2025 at Depai mologies.		All continuo variable used cu spline ter with kno placed
Bradshaw, 2019 - Model 3b (derivation						#		fix quant

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					В	MJ Open	36/bmjopen	Pag
	CRONICA S-CKD (derivation lab-free)					hypertension and currently under treatment).	by copyright, including for uses related to the resonant the diagnosis and the diagn	
3	Carrillo- Larco, 2017 - CRONICA S-CKD (validation complete)	n/a	7	NI	Age; hypertension; anemia.	Age (< 50, 50-69, ≥ 70 years), hypertension (blood pressure ≥ 140/9 mmHg OR previous diagnosis of hypertension and currently under treatment) and anemia (haemoglobir < 13 g/dL if male and < 12 g/dL if female).	conducted according to the recommendations of the 7th Joint National Committee on the diagnosis and	n/a
3	Carrillo- Larco, 2017 - CRONICA S-CKD (validation lab-free)	n/a	5	NI	Age; hypertension.	Age (< 50, 50-69, ≥ 70 years), hypertension (blood pressure ≥ 140/9 mmHg OR previous diagnosis of hypertension and currently under treatment).	Age (information was collected by trained fieldworkers through face-to-face interviews), hypertension (blood pressure measurements were conducted according to the recommendations of the 7th Joint National Committee on the diagnosis and nonagement of High Blood Pressure in adults (JNC-7), NI on anemia.	n/a
4	Mogueo, 2015 -	n/a	8	NI	Age; sex; diabetes mellitus; hypertension; use	Age (50-59, 60-69, ≥70); Female gender; Hypertension (history of	Participants received a standardized interview (Age	NI

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	Korean model (eGFR validation)				of statins; proteinuria	2 140 mining of diastolicblood pressure	according to the World Health Corganisation (WHO) Audidelines using a semi- automated digital blood Corporate Monitor (Rossmax Co	
4	Mogueo, 2015 - Thai model (eGFR validation) Mogueo,	n/a	8	NI	Age; diabetes mellitus; hypertension	Age (<40, 40-59, 60-69, >70); Hypertension (history of illness, taking antihyper-tensive drug(s) or had systolic blood pressure ≥140 mmHg of diastolicblood pressure ≥90 mmHg); Diabetes (history of illness, taking oral hypoglycaemicagents or fasting plasma glucose levels≥126 mg/dL) Age (50-59, 60-69, ≥70); Female	Participants with no history of coctor diagnosed diabetes matitus underwent a 75 g oral	NI
	Mogueo, 2015 - Korean model				Age; sex; diabetes mellitus; hypertension; use	Age (50-59, 60-69, ≥70); Female gender; Hypertension (history of illness, taking antihyper-tensive drug(s) or had systolic blood pressure	sendardized interview (Age and sex) and physical examination during which	
4	(eGFR or	n/a	8	NI	of statins; proteinuria	≥140 mmHg or diastolicblood pressure	blogd pressure was measured	NI

			36/bmjopen-202	Pa				
	proteinuria validation)			<i>^</i> <sub>C</sub>		≥90 mmHg); Diabetes (history of	Organisation (WHO) Significant of the World Health Organisation (WHO) Significant of the World Health Significant of the World Health Significant of the WHO Sig	
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	n/a	8	NI	Age; diabetes mellitus; hypertension	Age (<40, 40-59, 60-69, >70); Hypertension (history of illness, taking antihyper-tensive drug(s) or had systolic blood pressure ≥140 mmHg or diastolicblood pressure ≥90 mmHg); Diabetes (history of illness, taking oral hypoglycaemicagents or fasting	Participants received a standardized interview (Age) and physical examination dering which blood pressure was measured according to the World Health Organisation (WHO) guidelines using a stani-automated digital blood pressure monitor (Rossmax PD, USA) on the right arm in the sitting position.  Participants with no history of dector diagnosed diabetes malitus underwent a 75 g oral	NI
5	Saranburu t, 2017 - Framingh am Heart Study (MDRD validation)	n/a	5	NI	Diabetes mellitus; hypertension; eGFR category	Diabetes mellitus (yes); hypertension (yes); eGFR category (60-74, 75-89, 90-119)	Hypertension was defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or use for oral antihypertensive medication. Diabetes mellitus fivas defined as a fasting glocose of ≥126 mg/dl or use	n/a

0					В	MJ Open  By copyright, including	36/bmjopen-202	
						including for	使 medications. eGFR was estimated using the Madification of Diet in Renal 图sease (MDRD) equation.	
5	Saranburu t, 2017 - Framingh am Heart Study (CKD-EPI validation)	n/a	16	NI NI	Age; diabetes mellitus; hypertension; eGFR category	Age (30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-85); diabetes mellitus (yes); hypertension (yes); eGFR category (60-74, 75-89, 90-119)	TAge was obtained by a survey. Hypertension was defined as systolic blood pressure ≥ 140 mmHg or significant with the chronic kidney disease.  The Age was obtained by a survey. Hypertension was a fasting glucose of ≥126 mg/dl or use of medications.  The Chronic kidney disease.	n/a
	Saranburu				July 1	Age (<45, 45-54, 55-59, ≥55); Sex (male, female); Waist circumference	Age (health survey), sex (health survey). Hypertension was defined as systolic blood gressure ≥ 140 mmHg or diestolic blood pressure ≥ 90 mmHg or use of oral antihypertensive medication. Diabetes mellitus was defined a a fasting glucose of ≥126	
6	t, 2017 - Model 1 (derivation Clinical only)	15	15	NI	Age; sex; systolic blood pressure; waist circumference; diabetes mellitus	(≤80 for male or ≤90 for male, >80 for female or >90 for male); Diabetes (yes, no); Systolic blood pressure (<120, 120-129, 130-139, 140-149, 150-159, ≥160)	diabetes. Waist circumference	NI
	Saranburu t, 2017 - Model 1 BMI				Age; sex; systolic blood pressure; body mass index	Age (<45, 45-54, 55-59, ≥55); Sex (male, female); BMI (<25, ≥25); Diabetes (yes, no); Systolic blood pressure (<120, 120-129, 130-139,	Age (health survey), sex (halth survey). Hypertension was defined as systolic blood aressure ≥ 140 mmHg or diastolic blood pressure ≥ 90	
6	(derivation	15	15	NI	(BMI); diabetes mellitus	140-149, 150-159, ≥160)	mmHg or use of oral  m  r  r	NI

				ı			) <u> </u>	
	Clinical					<u> </u>	ar <b>g</b> ihypertensive medication.	
	only)						Di <b>g</b> betes mellitus was defined	
						رة	a <b>S</b> a fasting glucose of ≥126	
							n <b>g</b> /dl or a positive history of │	
						5	diabetes. Body mass index	
						ğ	was defined as weight in	
							_ <b>%</b> ilograms divided by the	
						2	Square of height in meters	
						2	ge (health survey), sex	
						[	Enealth survey). Hypertension	
							ਡਾਂ 暴 defined as systolic blood	
						á	ີ່ ≸ressure ≥ 140 mmHg or	
					1 6		di <b>ē</b> stolic blood pressure ≥ 90	
					Deer,		mmHg or use of oral	
						Ē	an hinypertensive medication.	
							Diabetes mellitus was defined	
							a <b>s</b> a fasting glucose of ≥126	
						چَ	nd/dl or a positive history of	
							dabetes. Serum creatinine	
							(Cr) was measured by the	
							enzymatic assay on the Vitros	
							350 analyzer (Ortho-Clinical	
						2	Diagnostics, USA) using	
							IBMS-Standard Reference	
	Saranburu						Material (SRM) 967 as the	
	t, 2017 -						stædard. Èstimate glomerular	
	Model 2						প্রাtration rate (eGFR) was	
	(derivation					Age (<45, 45-54, 55-59, ≥55); Sex	calculated according to two-	
	Clinical +				Age; sex; systolic blood	(male, female); Diabetes (yes, no);		
	Limited				pressure; diabetes	Systolic blood pressure (<120, 120-	ಪ Kidney Disease–	
	laboratory				mellitus; glomerular	129, 130-139, 140-149, 150-159,	ந்gidemiology Collaboration	
6	tests)	16	16	NI	filtration rate at baseline	≥160); eGFR (≥90, 75-89, 60-74)	(CKDEPI) equation	NI
-	Saranburu	-	-			Age (<45, 45-54, 55-59, ≥55); Sex	Age (health survey), sex	
	t, 2017 -				Age; sex; systolic blood	(male, female); Diabetes (yes, no);	(health survey). Hypertension	
	Model 3				pressure; diabetes	Systolic blood pressure (<120, 120-	was defined as systolic blood	
	(derivation				mellitus; glomerular	129, 130-139, 140-149, 150-159,	Fressure ≥ 140 mmHg or	
	Clinical +				filtration rate at baseline;	≥160); eGFR (≥90, 75-89, 60-74); Uric		
6	Full	22	20	NI	uric acid; hemoglobin	acid (>6 for female or >7 for male, $\leq$ 6	mmHg or use of oral	NI
<del>-</del>					23 40.4, 110.1110 9.00111	1 25.2 ( 5 16. 16.116.6 6. 7 16. 1116.6, =0		

f 100					В	MJ Open	36/bmjopen-202	
	laboratory tests)				) to 000 to 1000 to 10	for female or ≤7 for male); Hemoglobin (<12 for female or <13 for male, ≥12 for female or ≥13 for male)	ਤਾਂ ਨੂੰ ਕਿਲ੍ਹੇihypertensive medication.	
6	Saranburu t, 2017 - Model 1 (validation Clinical only)	n/a	15	NI	Age; sex; systolic blood pressure; waist circumference; diabetes mellitus	(yes, no); Systolic blood pressure (<120, 120-129, 130-139, 140-149, 150-159, ≥160)	a fasting glucose of ≥126 mg/dl or a positive history of diabetes. Waist circumference was measured midway between the lowest ribs and the iliac crest.	n/a
6	Saranburu t, 2017 - Model 2 (validation	n/a	16	NI	Age; sex; systolic blood pressure; diabetes mellitus; glomerular filtration rate at baseline	Age (<45, 45-54, 55-59, ≥55); Sex (male, female); Diabetes (yes, no); Systolic blood pressure (<120, 120-129, 130-139, 140-149, 150-159,	Tage (health survey), sex (health survey). Hypertension was defined as systolic blood gressure ≥ 140 mmHg or	n/a

					В	MJ Open	36/bmjopen	Pa
	Clinical + Limited laboratory tests)					≥160); eGFR (≥90, 75-89, 60-74)	diestolic blood pressure ≥ 90  ### mmHg or use of oral  ### and hypertensive medication.  Diasoetes mellitus was defined  ### assa fasting glucose of ≥126	
				76			mg/dl or a positive history of diabetes. Serum creatinine diabetes. Serum creating diabetes. Serum creatinine diab	
					Deer		dandard. Estimate glomerular elitration rate (eGFR) was calculated according to two-level race variable Chronic Kidney Disease—Epidemiology Collaboration (CKDEPI) equation	
	Thakkinsti an, 2011 (derivation	27	40	NI NI	Age; history of kidney stones; diabetes mellitus;	Age (<40, 40-59, 60-69, ≥70); getting the state of the s	medicines used or laboratory tests/physical examinations), shypertension (history of impess, relevant medicines of used or laboratory tests/physical examinations), and history of kidney stones	NII
7	Wen, 2020 - Simple Risk Score (derivation	37	10	NI Time-	hypertension  Waist circumference; systolic blood pressure;	84.9/75-79.9, 85-89.9/80-84.9, 90-94.9/85-89.9, ≥95/≥90 (for male/female)]; systolic blood pressure (<120, 120-139, 140-159, >160); sex (male, female); education (illiterate, primary school and above); diabetes	Dusing medical examinations, participants took two blood pressure measurements using a non-invasive automatic HEM-907 blood pressure monitor after 5 minutes of rest. Systolic blood	NI 
8	) [	NI	15	varying	sex; education; diabetes	(no or yes)	pressure was identified as the	NI

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					В	MJ Open	d by copyright, includ	36/bm jopen-202	Pa
						Age (≤ 40, 41–50, 51–60, 61–70,	ing for uses re	iligerate for 0 years, primary senool for 1–6 years, junior igh school for 7–9years, and senior high school for ≥10 ears); Sex was self-reported; anformation about waist	
9	Wu, 2016 (derivation	NI	10	Baseline	Age, gender and body mass index (BMI) status.	Age (≤ 40, 41–50, 51–60, 61–70, ≥71), gender (male, female) and bod mass index (BMI) status (normal, overweight: 23–24.9 kg/m2, obesity ≥25 kg/m2).  Age (≤ 40, 41 – 50, 51 – 60, 61 – 70	∖⁄⊓ / <del>≤</del>	kelf-renorted) and hody mass l	NI
9	Wu, 2016 (validation	n/a	10	Baseline	Age, gender and body mass index (BMI) status.	Age (≤ 40, 41 – 50, 51 – 60, 61 – 70, 71+), gender (male, female) and bod mass index (BMI) status (normal, overweight: 23–24.9 kg/m2, obesity ≥25 kg/m2).	V⊒.(S	seat-reported) and body mass (	n/a
							raining, and similar technologies.	bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA	43
				Forp	peer review only - http://bmjo	pen.bmj.com/site/about/guidelines.xhtr	nl		

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## S3.4 Table: Sample size and missing data

			Sample Siz	_	1 J	ssing Data	
N°	Study	Baselin e sample size	Number of outcome events	Total outcome devents per candidate or predictors	Figinssing data	Number of participant s with missing data	Missing data per candidat e predictor s
1	Asgari, 2020 European Risk Assessment tool (6-years validation)	3270	722	n/a 🛎	<b>&amp;</b> ∰mplete-case	2817	n/a
1	Asgari, 2020 European Risk Assessment tool (9-years validation)	3240	1359	n/a n	🕏 🕏 mplete-case	2847	n/a
2	Bradshaw, 2019 - Model 1 (derivation)	8698	947	31,57	<b>₹</b> mplete-case	896	29,87
2	Bradshaw, 2019 - Model 2 (derivation)	8698	947	41,17 នី	<u>Ce</u> mplete-case	896	38,96
2	Bradshaw, 2019 - Model 3a (derivation)	8698	947	NI B	C <b>@</b> mplete-case	896	NI
2	Bradshaw, 2019 - Model 3b (derivation)	8698	947	چ 118,38	Cemplete-case	896	112,00
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	4065	NI	n/a ъ	C <mark>o</mark> mplete-case	1300	n/a
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	4940	NI	n/a ភ្ន	Complete-case	1233	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	2368	81	2,25	Complete-case	235	6,53
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	2368	81	3,12 🥦	Complete-case	235	9,04
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	1459	79	n/a	Complete-case	79	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	1459	79	n/a 💆	Complete-case	79	n/a
4	Mogueo, 2015 - Korean model (eGFR validation)	902	259	n/a ∃	C <mark>e</mark> mplete-case	383	n/a
4	Mogueo, 2015 - Thai model (eGFR validation)	902	259	n/a	Complete-case	383	n/a
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	902	268	n/a 👸	Camplete-case	383	n/a
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	902	268	n/a	Cemplete-case	383	n/a
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	2141	222	n/a 👸	C <b>e</b> mplete-case	NI	n/a
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	2328	233	n/a 🖁	C <b>e</b> mplete-case	NI	n/a
6	Saranburut, 2017 - Model 1 (derivation Clinical only)	3186	271	18,07	Camplete-case	NI	NI
6	Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	3186	271	18,07	Cemplete-case	NI	NI
6	Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	3186	271	16,94	Complete-case	NI	NI
6	Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	3186	271	12,32	Complete-case	NI	NI
6	Saranburut, 2017 - Model 1 (validation Clinical only)	1395	27	n/a	Camplete-case	NI	NI

	ВМЈ Ор	oen		2	36/bmjopen-2021-05@mplete-case		F
				9	n-202 aht. i		
6	Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	1395	27		Cemplete-case	NI	NI
7	Thakkinstian, 2011 (derivation)	3459	626	16,92	NO #	NI	NI
8	Wen, 2020 - Simple Risk Score (derivation)	3266	590	NI	Complete-case	992	NI
8	Wen, 2020 - Best-fit Risk Score (derivation)	3266	590	'*'	Complete-case	992	NI
9	Wu, 2016 (derivation)	14374	294	NI	Complete-case	3135	NI
9	Wu, 2016 (validation)	4371	48	n/a	Months of the control	911	n/a
	Wu, 2016 (derivation) Wu, 2016 (validation)				)ownloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA logeschool .		45
	For peer review only - http://bmjopen.b	mj.com/site	r/about/guic	ieiines.xhtml			

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## S3.5 Table: Model development

				Mo	del Development	7 J	
N°	Study	Regressio n method	Were the model assumptions verified?	Predictors selection	If the prediction model was a replication, which was the original model?	sh mathematical stress of the	Was a hrinkag e nethod used?
_	Asgari, 2020 European Risk	-/-	/	- 1-	2/2	n/a	-1-
1	Assessment tool (6-years validation)	n/a	n/a	n/a	n/a	n/a	n/a
1	Asgari, 2020 European Risk Assessment tool (9-years validation)	n/a	n/a	n/a	n/a	ta · ta · n/a	n/a
2	Bradshaw, 2019 - Model 1 (derivation)	Logistic	NI	Pre-selection	· ·	Step-down selection procedure based on the Akaike information criterion to select the final predictors	No
2	Bradshaw, 2019 - Model 2 (derivation)	Logistic	NI	Pre-selection	n/a	Step-down selection procedure based on the Akaike information criterion to select the final predictors	No
2	Bradshaw, 2019 - Model 3a (derivation)	Logistic	NI	Pre-selection		Step-down selection procedure based on the Akaike information criterion to select the final predictors	No
2	Bradshaw, 2019 - Model 3b (derivation)	Logistic	NI	Pre-selection	n/a	Step-down selection procedure based on the Akaike information criterion to select the final predictors	No
	Bradshaw, 2019 - Model 3a (CARRS-I					at .	
2	urban validation)	n/a	n/a	n/a	n/a	n/a	n/a
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	n/a	n/a	n/a	n/a	part n/a	n/a
3	Carrillo-Larco, 2017 - CRONICAS- CKD (derivation complete)	Logistic	NI	Pre-selection	n/a	Steadwise backward elimination method	No

			ВМЈ	Open		36/bmjopen-202	
	Carrillo-Larco, 2017 - CRONICAS-				,	Estegwise backward elimination method	
3	CKD (derivation lab-free)	Logistic	NI	Pre-selection	n/a	method	No
3	Carrillo-Larco, 2017 - CRONICAS- CKD (validation complete)	n/a	n/a	n/a	n/a	or n/a	n/a
	Carrillo-Larco, 2017 - CRONICAS-	/-	/	1		15	/-
3	CKD (validation lab-free)	n/a	n/a	n/a	n/a	<b>%</b> <u>×</u> n/a	n/a
4	Mogueo, 2015 - Korean model (eGFR validation)	n/a	n/a	n/a	n/a	n/a arch 2 Eras	n/a
4	Mogueo, 2015 - Thai model (eGFR validation)	n/a	n/a	n/a	n/a	n/a n/a	n/a
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	n/a	n/a	n/a	n/a	Down n/a	n/a
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	n/a	n/a	n/a	n/a	d dat	n/a
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	n/a	n/a	n/a	n/a	m. if from n/a	n/a
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	n/a	n/a	n/a	n/a	ng, http n/a	n/a
6	Saranburut, 2017 - Model 1 (derivation Clinical only)	Logistic	NI	Pre-selection	n/a	Variables were sequentially added in a pre-specified order and incorporated using a p   0.95 threshold for entry and retention in the final model	No
6	Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	Logistic	NI	Pre-selection	n/a	a. Variables were sequentially added in a pre-specified order and incorporated using a p< 7 0.05 threshold for entry and restention in the final model	No
	Saranburut, 2017 - Model 2 (derivation	Logistic				Variables were sequentially eadded in a pre-specified order and incorporated using a p<	
6	Clinical + Limited laboratory tests)	Logistic	NI	Pre-selection	n/a	rឝ៊ីention in the final model	No
	Saranburut, 2017 - Model 3 (derivation					Variables were sequentially added in a pre-specified order and incorporated using a p<0.25 threshold for entry and	
6	Clinical + Full laboratory tests)	Logistic	NI	Pre-selection	n/a	reention in the final model	No

1			ВМЈ	Open		36/bmjopen-2021-058921 on	
	0					-2021- ht, inc	
6	Saranburut, 2017 - Model 1 (validation Clinical only)	n/a	n/a	n/a	n/a	05 89 n/a	n/a
	Saranburut, 2017 - Model 2 (validation	11/a	II/a	II/a	11/4	<u>ii</u> <u>ii</u> <u>ii</u> 2	II/a
6	Clinical + Limited laboratory tests)	n/a	n/a	n/a	n/a	or n/a	n/a
		100	Or to			Factors with p values < 0.15 in a univariate analysis were considered to be considered to b	
7	Thakkinstian, 2011 (derivation)  Wen, 2020 - Simple Risk Score	Logistic	NI	Pre-selection	n/a	The final parsimonious model.  Risk factors were investigated by forward stepwise logistic regression and only statiscally significant (a two-sided P value \$\)0.05) risk factors were	No
8	(derivation)  Wen, 2020 - Best-fit Risk Score	Logistic	NI	Pre-selection	n/a	retained.  Risk factors were retained.  Risk factors were investigated by forward stepwise logistic gregression and only statiscally significant (a two-sided P value \$0.05) risk factors were	No
8	(derivation)	Logistic	NI	Pre-selection	n/a	netained.	No
9	Wu, 2016 (derivation)	Logistic	NI	Pre-selection	n/a	Spowise logistic regression model. Variables with a p value less than 0.1 were kept in the final model.	No
9	Wu, 2016 (validation)	n/a	n/a	n/a	n/a	G n/a	n/a

## S3.6 Table: Model performance

			B≀	36/bmjopen d by copyrig		
	ot applicable; NI: no information  Table: Model performan	ce		36/bmjopen-2021-058921 o by copyright, including fo		
				Model Performance		
N°	Study	Calibration	Discrimination (%)	March 2022. Downloade Erasmushogeschodes related to ext and da measurext and da Classification	Cut-off point	For replication on studies, was the cut-off the same?
1	Asgari, 2020 European Risk Assessment tool (6- years validation)	Hosmer-Lemeshow X2 test (for intercept adjusted model): 13.53 with a p-value 0.09 (for male) and 10.1 with a p-value 0.26 (for women)	AUC (95% CI) for final intercept adjusted model = Male: 0.76 (0.72- 0.79) and Female: 0.71 (0.69-0.73)	Men: Sensitivity = 72.7%, Specificity = 65.6%. Womer Sensitivity = 66.8%, Specificity = 65.6%.	: Men: 25. Women: 19	No
1	Asgari, 2020 European Risk Assessment tool (9- years validation)	Hosmer-Lemeshow X2 test (for intercept adjusted model): 12.54 with a p-value 0.13 (for male) and 8.19 with a p-value 0.41 (for women)	AUC (95% CI) for final intercept adjusted model = Male: 0.71 (0.67- 0.74) and Female: 0.70 (0.68-0.73)	Men: Sensitivity = 64.5%, Specificity = \$\frac{1}{2}\$. Womer Sensitivity = 56.9%, Specificity = \$\frac{1}{2}\$.6%	: Men: 25. Women: 23	No
	Bradshaw, 2019 - Model	Calibration slope:	C-statistic (95% CI)	Sensitivity = 72%, Specificity = 72%, PPV = 24%, NPV	/	
2	1 (derivation)	0.96	= 0.79 (0.78-0.81)	- 90% <b>5</b> 1	0.09	n/a
2	Bradshaw, 2019 - Model 2 (derivation)	Calibration slope: 0.98	C-statistic (95% CI) = 0.73 (0.72-0.75)	Sensitivity = 68%, Specificity = 67%, PP\\ <sup>2</sup> = 20%, NP\ = 95%	0.09	n/a
2	Bradshaw, 2019 - Model 3a (derivation)	Calibration slope: 0.98	C-statistic (95% CI) = 0.77 (0.75-0.79)	Sensitivity = 71%, Specificity = 70%, PPV = 22%, NPV = 95%	0.09	n/a
2	Bradshaw, 2019 - Model 3b (derivation)	Calibration slope: 0.99	C-statistic (95% CI) = 0.77 (0.76-0.79)	Sensitivity = 71%, Specificity = 70%, PP\\$= 22%, NP\ = 95%	0.09	n/a

100			ВМ	36/bmjopen-2021-058921 on d by copyright, including for Open		
				en-2021 right, in		
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	NI	C-statistic (95% CI) = 0.74 (0.73-0.74)	-058921 cluding Z	0.09	Yes
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	NI	C-statistic (95% CI) = 0.70 (0.69-0.71)	us us	0.09	Yes
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Hosmer-Lemeshow X2 test: 4.13 with a p-value of 0.53 (for final multivariable model).	AUC = 76.2%	NI SE SM arch 2022 PPV = 8.8%, NPV = 99.1%, LHR+ = 2.8, LES - 0.3	2	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	Hosmer-Lemeshow X2 test: 4.13 with a p-value of 0.53 (for final multivariable model).	AUC = 76%	wnnloade geschool geschool and date of the second d	2	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	NI	AUC = 70.0%.	Sensitivity = 70.5%, Specificity = 69.1%, BPV = 11.4%, NPV = 97.6%, LHR+ = 2.3, LHR- 0.4	2	Yes
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	NI	AUC = 70.0%.	Sensitivity = 70.5%, Specificity = 69.7%, PPV = 11.6%, NPV = 97.7%, LHR+ = 2.3, LHR-3= 0.4	2	Yes
4	Mogueo, 2015 - Korean model (eGFR validation)	Expected/Observed rate (95%) = 0.76 (0.67-0.86); Brier score = 0.164; Yates slope = 0.208	C-statistic (95% CI) = 0.797 (0.765- 0.829)	similar similar 87% Sensitivity = 82%, Specificits = 67%	0.30	NI
4	Mogueo, 2015 - Thai model (eGFR validation)	Expected/Observed rate (95%) = 0.98 (0.87-1.10); Brier score = 0.165; Yates slope = 0.200	C-statistic (95% CI) = 0.760 (0.726-	May 13, 2020 chnologies. 2020 Sensitivity = 73%, Specificity = 82%	0.31	NI
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Expected/Observed rate (95%) = 0.76 (0.67-0.85); Brier score = 0.161; Yates slope = 0.225	C-statistic (95% CI) = 0.811 (0.780-	Sensitivity = 84%, Specificity = \$8%	0.31	NI
	proteinana vandation)	Tates slope - 0.225	0.042)	G m	0.51	111

			ВЛ	36/bmjopen-2021-05892 d by copyright, including open		Pa
	Mogueo, 2015 - Thai	Expected/Observed rate (95%) = 0.97 (0.86-1.09); Brier	C-statistic (95% CI)	including		
	model (eGFR or	score = 0.164;	= 0.772 (0.739-	for		
4	proteinuria validation)	Yates slope = 0.211	0.805)	Sensitivity = 74%, Specificits = 73%	0.32	NI
	Saranburut, 2017 - Framingham Heart Study	Hosmer-Lemeshow X2 test: 30.2	AUC (95% CI) =	March Er Es rela		
5	(MDRD validation)	(p<0.001)	0.69 (0.66-0.73)	141 🛱 🥨 –	NI	NI
	Saranburut, 2017 - Framingham Heart Study	Hosmer-Lemeshow X2 test: 256.5	AUC (95% CI) =	2022 ed to		
5	(CKD-EPI validation)	(p<0.001)	0.63 (0.57-0.65)	n. Do	NI I	NI
	Saranburut, 2017 - Model	Hosmer-Lemeshow	0.00 (0.01 0.00)	ct a	1	
	1 (derivation Clinical	X2 test: 9.02	AUC (95% CI) =	nd nd		
6	only)	(p=0.34)	0.72 (0.69-0.75)	NI da	NI	n/a
	Saranburut, 2017 - Model	Hosmer-Lemeshow	1110 (050) 011	a m		
6	1 BMI (derivation Clinical	X2 test: 8.87 (p=0.35)	AUC (95% CI) = 0.72 (0.69-0.75)	minin NI	NI NI	n/a
-6	only) Saranburut, 2017 - Model	Hosmer-Lemeshow	0.72 (0.69-0.75)	(0	INI	TI/a
	2 (derivation Clinical +	X2 test: 10.87	AUC (95% CI) =	ttp://		
6	Limited laboratory tests)	(p=0.21)	0.79 (0.76-0.82)	p://bm Al trai	l NI l	n/a
	Saranburut, 2017 - Model	Hosmer-Lemeshow	,	ning,		
	3 (derivation Clinical +	X2 test: 8.28	AUC (95% CI) =			
6	Full laboratory tests)	(p=0.41)	0.80 (0.77-0.82)	NI and	NI	n/a
	Carranhum t 2017 Madal	Hosmer-Lemeshow	ALIO (050/ OI) -	sir		
6	Saranburut, 2017 - Model 1 (validation Clinical only)	X2 test: 4.31 (p=0.229)	AUC (95% CI) = 0.66 (0.55-0.78)	j.com/ similar	NI	NI
	Saranburut, 2017 - Model	Hosmer-Lemeshow	0.00 (0.55-0.70)	, 6	INI	INI
	2 (validation Clinical +	X2 test: 2.29	AUC (95% CI) =	n May . techno		
6	Limited laboratory tests)	(p=0.514)	0.88 (0.80-0.95)		NI	NI
		Calibration was		13, 20%		
		assessed by		2025 jies.		
		subtracting the two		5 at		
		Somer's D correlation		at Depar		
		coefficients: 0.045		βρα		
	Thakkinstian, 2011	(95% CI: 0.034-	C-statistic of internal	r <del>t</del> m		
7	(derivation)	0.057)	validation = 0.741	Sensitivity = 76%, Specificity = ∰9%	5	n/a

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		Hosmer-Lemeshow		<u> </u>		
				<u></u>		
	Wen, 2020 - Simple Risk	X2 test: 4.89	AUC (95% CI) =	Sensitivity = 70.49%, Specificity = ₹5.1%%, PPV =		
8	Score (derivation)	(p=0.769)	0.717 (0.689-0.744)	29.8%, NPV = 91.3%, LHR+ = 2.02, LER- = 0.45	14	n/a
		Hosmer-Lemeshow		on		
	Wen, 2020 - Best-fit Risk	X2 test: 2.52	AUC (95% CI) =	Sensitivity = 56.83%, Specificity = <b>5</b> 6.6 %, PPV =		
8	Score (derivation)	(p=0.961)	0.721 (0.693-0.748)	33.8%, NPV = 89.4%, LHR+ = 2.4 <b>3</b> , L <b>2</b> R- = 0.56	24	n/a
		Internal validation		arc E rel		
		dataset: Hosmer-	AUC (95% CI) of	late		
		Lemeshow X2 test	internal validation =	202 Sm d t		
(	Wu, 2016 (derivation)	P=0.798	0.894 (0.861-0.926)	Sensitivity = 0.820, Specificit ₹ 👼 🗗 863	36	n/a
			AUC = 0.880	Do		
		Hosmer-Lemeshow	(95%CI: 0.829-	l ar		
(	Wu, 2016 (validation)	X2 test P=397	0.931)	NI a sc a	NI	NI

AUC, area under the curve; CI, confident interval; NI, no information.

			Re	sults	
N°	Study	Was a simplified model presente d?	Were the coefficien ts of the regressio n model presente d?	Was the baseline risk presente d?	Were there alternative results presentati on?
	Asgari, 2020 European Risk Assessment tool				
1	(6-years validation) Asgari, 2020 European Risk Assessment tool	No	No	Yes	No
1	(9-years validation) Bradshaw, 2019 -	No	No	Yes	No
2	Model 1 (derivation)  Bradshaw, 2019 -	Yes	No	No	No
2	Model 2 (derivation)  Bradshaw, 2019 -	Yes	No	No	No
2	Model 3a (derivation)  Bradshaw, 2019 -	No	No	No	No
2	Model 3b (derivation)  Bradshaw, 2019 -	Yes	No	No	No
2	Model 3a (CARRS-I urban validation)	No	No	No	No
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	No	No	No	No
•	Carrillo-Larco, 2017 - CRONICAS-CKD		0.		
3	(derivation complete) Carrillo-Larco, 2017 - CRONICAS-CKD	Yes	Yes	No	No
3	(derivation lab-free) Carrillo-Larco, 2017 - CRONICAS-CKD	No	Yes	No	No
3	(validation complete)  Carrillo-Larco, 2017 -	Yes	No	No	No
3	CRONICAS-CKD (validation lab-free)	No	No	No	No
4	Mogueo, 2015 - Korean model (eGFR validation)	No	No	No	No
4	Mogueo, 2015 - Thai model (eGFR validation)	No	No	No	No
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	No	No	No	No
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	No	No	No	No
5	Saranburut, 2017 - Framingham Heart	No	Yes	No	No

	04 1 (14000		I	I	
	Study (MDRD				
	validation) Saranburut, 2017 -				
	Framingham Heart				
	Study (CKD-EPI				
5	validation)	No	Yes	No	No
	Saranburut, 2017 -	_			-
	Model 1 (derivation				
6	Clinical only)	No	Yes	No	Yes
	Saranburut, 2017 -				
	Model 1 BMI (derivation				
6	Clinical only)	No	No	No	Yes
	Saranburut, 2017 -				
	Model 2 (derivation				
6	Clinical + Limited	Vaa	Vaa	No	Vaa
6	laboratory tests)	Yes	Yes	No	Yes
	Saranburut, 2017 - Model 3 (derivation				
	Clinical + Full laboratory				
6	tests)	Yes	Yes	No	No
	Saranburut, 2017 -			110	
	Model 1 (validation				
6	Clinical only)	No	No	No	Yes
	Saranburut, 2017 -				
	Model 2 (validation				
_	Clinical + Limited				
6	laboratory tests)	Yes	No	No	Yes
7	Thakkinstian, 2011		Vaa	Nia	V
7	(derivation)	No	Yes	No	Yes
8	Wen, 2020 - Simple Risk Score (derivation)	No	Yes	Yes	Yes
U	Wen, 2020 - Best-fit	INU	162	162	1 62
8	Risk Score (derivation)	No	Yes	Yes	Yes
9	Wu, 2016 (derivation)	No	Yes	No	Yes
9	Wu, 2016 (validation)	No	Yes	No	Yes
	vvu, 2010 (validation)	140	163	INO	163

# S3.8 Table: Discussion

			Discussion	
N°	Study	Interpretation of the results	Comparison with other studies in LAC	Generalizability
_	Asgari, 2020 European Risk Assessment			Non-
1	tool (6-years validation)	Exploratory	No	generalizability
,	Asgari, 2020 European Risk Assessment		No	Non-
1	tool (9-years validation)	Exploratory	No	generalizability
2	Bradshaw, 2019 - Model 1 (derivation)	NI	No	NI NI
2	Bradshaw, 2019 - Model 2 (derivation)	NI	No	NI Name
2	Bradshaw, 2019 - Model 3a (derivation)	Confirmatory	Yes	Non- generalizability
2	Bradshaw, 2019 - Model 3b (derivation)	NI	No	NI
	Bradshaw, 2019 - Model 3a (CARRS-I			Non-
2	urban validation)	Confirmatory	Yes	generalizability
	Bradshaw, 2019 - Model 3a (UDAY rural	,		Non-
2	validation)	Confirmatory	Yes	generalizability
	Carrillo-Larco, 2017 - CRONICAS-CKD			
3	(derivation complete)	Exploratory	Yes	Generalizable
	Carrillo-Larco, 2017 - CRONICAS-CKD			
3	(derivation lab-free)	Exploratory	Yes	Generalizable
ا ۾ ا	Carrillo-Larco, 2017 - CRONICAS-CKD	C. mla mata m.	V	Oamanalizabla
3	(validation complete)	Exploratory	Yes	Generalizable
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	Exploratory	Yes	Generalizable
3	Mogueo, 2015 - Korean model (eGFR	Lxpioratory	165	Non-
4	validation)	Exploratory	Yes	generalizability
	Mogueo, 2015 - Thai model (eGFR	Exploratory	1.00	Non-
4	validation)	Exploratory	Yes	generalizability
	Mogueo, 2015 - Korean model (eGFR or			Non-
4	proteinuria validation)	Exploratory	Yes	generalizability
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Exploratory	Yes	Non- generalizability
	Saranburut, 2017 - Framingham Heart	,		Non-
5	Study (MDRD validation)	Exploratory	No	generalizability
	Saranburut, 2017 - Framingham Heart			Non-
5	Study (CKD-EPI validation)	Exploratory	No	generalizability
	Saranburut, 2017 - Model 1 (derivation		ļ .,	Non-
6	Clinical only)	Exploratory	No	generalizability
	Saranburut, 2017 - Model 1 BMI	Evolorotor:	Nio	Non-
6	(derivation Clinical only) Saranburut, 2017 - Model 2 (derivation	Exploratory	No	generalizability Non-
6	Clinical + Limited laboratory tests)	Exploratory	No	generalizability
	Saranburut, 2017 - Model 3 (derivation	Exploratory	140	Non-
6	Clinical + Full laboratory tests)	Exploratory	No	generalizability
	Saranburut, 2017 - Model 1 (validation	,		Non-
6	Clinical only)	Exploratory	No	generalizability
	Saranburut, 2017 - Model 2 (validation			Non-
6	Clinical + Limited laboratory tests)	Exploratory	No	generalizability
				Non-
7	Thakkinstian, 2011 (derivation)	Confirmatory	No	generalizability

	Wen, 2020 - Simple Risk Score			Non-
8	(derivation)	Confirmatory	Yes	generalizability
	Wen, 2020 - Best-fit Risk Score			Non-
8	(derivation)	Exploratory	Yes	generalizability
				Non-
9	Wu, 2016 (derivation)	Exploratory	No	generalizability
				Non-
9	Wu, 2016 (validation)	Exploratory	No	generalizability



S4 Table: PROBAST S4.1 Table: Risk of Bias (RoB)	BMJ Open		36/bmjopen-2021-058921 on 15		
Study	Were appropriate data sources used, e.g., cohort, RCT, or nested case-control study data?	Were all inclusions and exclusions of participants appropriate?	Warch 2022. Downloaded Erasmashogeschool of the control of the con	Predictors  Were predictor assessments made without knowledge of outcome data?	Are all predictors available at the time the model is intended to be used?
Asgari, 2020 European Risk Assessment tool (6-years validation)	Y	Y	fron Y	Υ	Y
Asgari, 2020 European Risk Assessment tool (9-years validation)	Y	Y	ing, A	Υ	Y
Bradshaw, 2019 - Model 1 (derivation)	Y	Y	Y tra	Υ	PY
Bradshaw, 2019 - Model 2 (derivation)	Υ	Y	y y	Υ	Υ
Bradshaw, 2019 - Model 3a (derivation)	Y	Y	Y 2 2	Υ	PY
Bradshaw, 2019 - Model 3b (derivation)	Y	Y	Y md (	Υ	PY
Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Y	Y	similar Y	Υ	PY
Bradshaw, 2019 - Model 3a (UDAY rural validation)	Y	Y		Υ	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Y	Y	n Ma	Υ	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	Y	Y	y noic	Υ	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	Y	Y	13, 202 logies.	Υ	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	Y	Y	1 5	Υ	Y
Mogueo, 2015 - Korean model (eGFR validation)	Y	Y	Y at D	Υ	PY
Mogueo, 2015 - Thai model (eGFR validation)	Y	Y	Y eg	Υ	Y
Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Y	Y	at Department	Υ	PY
Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Y	Y	Y ent ଜ	Y	Y

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Saranburut, 2017 - Framingham Heart Study (MDRD validation) Saranburut, 2017 - Framingham Heart Study (CKD-EPI	Υ		A -		1
	ı	Υ	Y Clu	Υ	PY
validation)	Y	Y	1-058921 on 15 M	Υ	PY
Saranburut, 2017 - Model 1 (derivation Clinical only)	Y	Y	on 15	Υ	Y
Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	Y	Υ	Y es M	Υ	Y
Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	Y	Υ	Parch 2022. I Erasmush Frelated to to	Υ	PY
Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	Υ	Υ	2022. I smus ed to t	Υ	PY
Saranburut, 2017 - Model 1 (validation Clinical only)	Υ	Υ	Y 💥 🥇 🗸	Υ	Y
Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	Y	Y	wnloaded geschool and data	Υ	PY
Thakkinstian, 2011 (derivation)	Υ	Y	Y as o eq	Y	Y
Wen, 2020 - Simple Risk Score (derivation)	Y	Y	Y mining,	Y	Y
Wen, 2020 - Best-fit Risk Score (derivation)	Y	Y	Y g	Y	Y
Wu, 2016 (derivation)	Y	Y	Y <u>≥</u> 및	Y	Y
Wu, 2016 (validation)	Y	• Y	Y 2 3	Υ	Y
		ible).	p://bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA AI training, and similar technologies. >>>		

	ВМЈ	Open		36/bmjopen-2021-		
Study	Was the outcome determined appropriately?	Was a prespecified or standard outcome definition used?	Were predictors excluded from the	war to the control of the control o	Was the outcome determined without knowledge of predictor information?	Was the time interval between predictor assessment and outcome determination appropriate?
Asgari, 2020 European Risk Assessment tool (6-years validation)	Y	Y	Y	wnloaded yesshool and data	NI	Y
Asgari, 2020 European Risk Assessment tool (9-years validation)	CY.	Y	Y	from h	NI	Y
Bradshaw, 2019 - Model 1 (derivation)	Ý	Y	Y	ΣΫ́	NI	PY
Bradshaw, 2019 - Model 2 (derivation)	Y	Y	Y	Al training,	NI	Y
Bradshaw, 2019 - Model 3a (derivation)	NI	Y	Y	oen.bm Y and	NI	PY
Bradshaw, 2019 - Model 3b (derivation)	Y	Υ	Y	nj.cor Y Simi	NI	PY
Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Y	Y	Y	Y on	NI	PY
Bradshaw, 2019 - Model 3a (UDAY rural validation)	Y	Y	Y	May Y Chno	NI	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Y	Y	Y	13, 2025 } logies.	PY	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab- free)	Y	Y	Y	at Depa	PY	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	Y	Y	Y	rtment @	PY	PY

	ВМЈ	Open		36/bmjopen-2021-058921 >- 1 by copyright, including		
Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	Υ	Y	Y	21-05892 >- ncluding	PY	Y
Mogueo, 2015 - Korean model (eGFR validation)	Υ	Y	Y	on 1 for u	NI	PY
Mogueo, 2015 - Thai model (eGFR validation)	Υ	Y	Y	5 Ma Y Ses -	NI	Y
Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Υ	Y	Y	ch 2022 Erasmu slated to	NI	PY
Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Υ	Y	Y	Downlo shægeso text and	NI	Y
Saranburut, 2017 - Framingham Heart Study (MDRD validation)	Y	Y	Y	baded fro shool .	NI	PY
Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Y	Y	Y	om http: > Ining, A	NI	PY
Saranburut, 2017 - Model 1 (derivation Clinical only)	Y	Y	Υ	//bmj } train	NI	Υ
Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	Y	Y	Υ	open Y ing,	NI	Y
Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	Y	Y	Y	ı.bmj.com/ on l ≻ and similar te	NI	PY
Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	Y	Y	Y	on May 13,	NI	PY
Saranburut, 2017 - Model 1 (validation Clinical only)	Y	Y	Υ	y 13, > nolog	NI	Y
Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	Y	Y	Y	2025 at >- ies.	NI	PY
Thakkinstian, 2011 (derivation)	Y	Y	Y	Depa ^	NI	Y
Wen, 2020 - Simple Risk Score (derivation)	Υ	Y	Y	irtmen Y	NI	Y

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larch 2022. Downloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA Erasmushogeschool . related to text and data mining, Al training, and similar technologies.

Wen, 2020 - Best-fit Risk Score (derivation)	Y	Y	Y	21-058921 or 	NI	Y
Wu, 2016 (derivation)	Y	Y	Y	921 1091	NI	Y
Wu, 2016 (validation)	Y	Y	Y	om 15 N	NI	Y
Answer options: Y (yes), PY (probably yes), N (no), PN (probably no), N	I (no information), n/a (	not applicable).	10,	larch 2022. Downloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Departm Erasmushogeschool . s related to text and data mining, Al training, and similar technologies.		

			ВМЈ	Open	Analysis	by copyright, including fo	36/bm jopen-2021-058 <b>9</b> 21 o		
Study	Were there a reasonabl e number of participan ts with the outcome?	Were continuou s and categorical predictors handled appropriat ely?	Were all enrolled participan ts included in the analysis?	Were participants with missing data handled appropriatel y?	Was selection of predictors based on univariabl e analysis avoided? [develop ment studies only]	Weres complexiti es in tate data (et al censoris subjects competant risks and a samplification of configuration s)	were relevant model performan ce measures evaluated appropriat ely?	Were model overfittin g and optimism in model performa nce accounte d for? [develop ment studies only]	Do predictors and their assigned weights in the final model correspond to the results from the reported multivariable analysis? [developmen t studies only]
Asgari, 2020 European Risk Assessment tool (6-years validation)	Y	Y	N	N	n/a	and sim	bmi Co	n/a	n/a
Asgari, 2020 European Risk Assessment tool (9-years validation)	Y	Y	N	N	n/a	lar tech	N N	n/a	n/a
Bradshaw, 2019 - Model 1 (derivation)	Y	N	N	N	N	NI Olog	Y 13	Y	NI
Bradshaw, 2019 - Model 2 (derivation)	Y	N	N	N	N	NI es.	Y 2025	Y	NI
Bradshaw, 2019 - Model 3a (derivation)	NI	NI	N	N	N		ar Y	Y	NI
Bradshaw, 2019 - Model 3b (derivation)	Y	N	N	N	N	NI	<del>pparti</del> Y	Y	NI
Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	NI	Y	N	N	n/a	NI	<del>pe</del> NI	n/a	n/a

			ВМЈ (	Open		by copyright, including			
Bradshaw, 2019 - Model 3a (UDAY rural validation)	NI	Y	N	N	n/a	ncluding Z	NI NI	n/a	n/a
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	N	N	N	N	N	for uses	S N	Y	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	N	N	N	N	N	Erasmushoge related to text a Z Z	N	Y	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	N	Y	N	N	n/a	nushoge to text a Z	N	n/a	n/a
Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	N	OY	N	N	n/a	aschool and data Z	N	n/a	n/a
Mogueo, 2015 - Korean model (eGFR validation)	Υ	Y	N	N	n/a	mining, Z	PY	n/a	n/a
Mogueo, 2015 - Thai model (eGFR validation)	Υ	Y	N	N	n/a	Al train Z	PY	n/a	n/a
Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Υ	Y	N	N	n/a	ing, and Z	PY	n/a	n/a
Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Υ	Y	N	N	n/a	similar Z	PY	n/a	n/a
Saranburut, 2017 - Framingham Heart Study (MDRD validation)	Υ	Y	N	N	n/a	technol		n/a	n/a
Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Υ	Y	N	N	n/a	logies. Z	N N	n/a	n/a
Saranburut, 2017 - Model 1 (derivation Clinical only)	PY	N	N	N	N	NI	N	Y	Y
Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	PY	N	N	N	N	NI	N	Y	NI

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similar technologies.

			ВМЈ	Open		by copyright, including	3		
Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	PY	N	N	N	N	ncluding		Y	Y
Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	PN	N	N	N	N	for uses	S N	Y	Y
Saranburut, 2017 - Model 1 (validation Clinical only)	N	Y	N	N	n/a	Erasm s related t Z	N N	n/a	n/a
Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	N	Y	N	N	n/a	NI O S	N	n/a	n/a
Thakkinstian, 2011 (derivation)	PY	N	NI	NI	N	N N	N	Y	Y
Wen, 2020 - Simple Risk Score (derivation)	NI	N	N	N	N	NI mini	N	N	Y
Wen, 2020 - Best-fit Risk Score (derivation)	NI	N	N	N	N	ng, Al tr	N	N	Y
Wu, 2016 (derivation)	NI	N	N	N	N	NI nin	. N	N	Y
Wu, 2016 (validation)	N	Y	N	N	n/a	g, and	N	n/a	Y

Answer options: Y (yes), PY (probably yes), N (no), PN (probably no), NI (no information), n/a (not applicable).

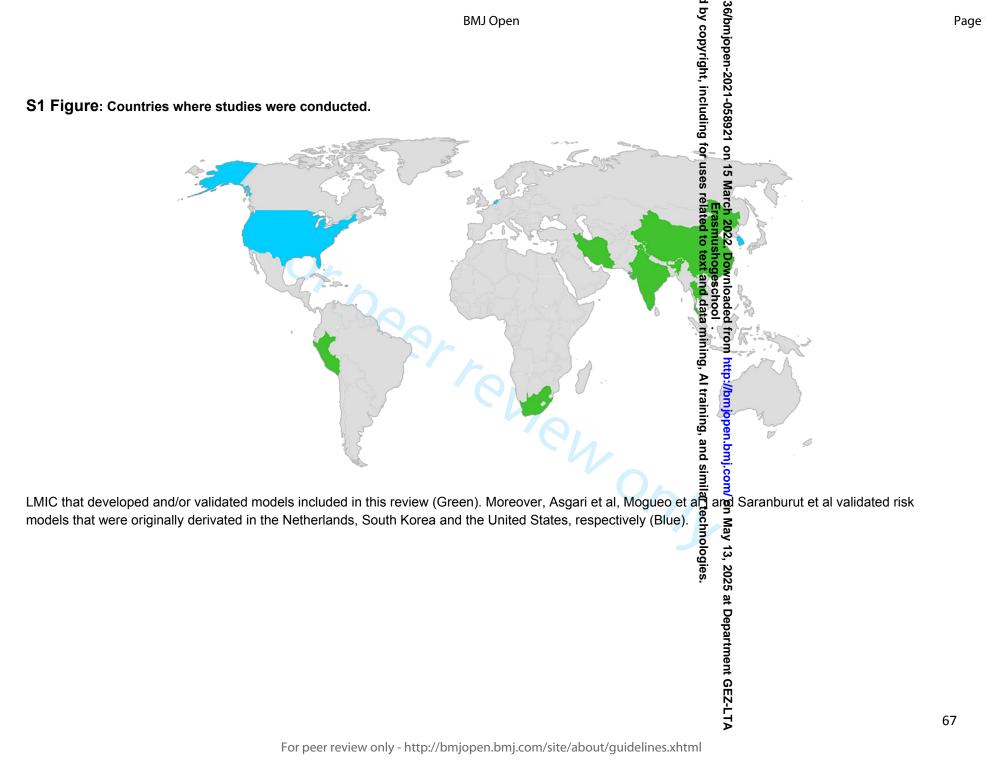
# S4.2 Table: Applicability

		I		
N°	Study	Participants	Predictors	Outcome
	Asgari, 2020 European Risk Assessment			
1	tool (6-years validation)	Low	Low	Low
	Asgari, 2020 European Risk Assessment			
1	tool (9-years validation)	Low	Low	Low
2	Bradshaw, 2019 - Model 1 (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 2 (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3a (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3b (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	Low	Low	Low
	Carrillo-Larco, 2017 - CRONICAS-CKD			
3	(derivation complete)	Low	Low	Low
2	Carrillo-Larco, 2017 - CRONICAS-CKD	Law	Low	Lave
3	(derivation lab-free) Carrillo-Larco, 2017 - CRONICAS-CKD	Low	Low	Low
3	(validation complete)	Low	Low	Low
	Carrillo-Larco, 2017 - CRONICAS-CKD	LOW	LOW	LOW
3	(validation lab-free)	Low	Low	Low
	Mogueo, 2015 - Korean model (eGFR	0		
4	validation)	Low	Low	Low
4	Mogueo, 2015 - Thai model (eGFR	Low	Low	Low
4	validation) Mogueo, 2015 - Korean model (eGFR or	LOW	Low	Low
4	proteinuria validation)	Low	Low	Low
	Mogueo, 2015 - Thai model (eGFR or			
4	proteinuria validation)	Low	Low	Low
	Saranburut, 2017 - Framingham Heart			
5	Study (MDRD validation)	Low	Low	Low
_	Saranburut, 2017 - Framingham Heart	Low	Low	Low
5	Study (CKD-EPI validation) Saranburut, 2017 - Model 1 (derivation	Low	Low	Low
6	Clinical only)	Low	Low	Low
	Saranburut, 2017 - Model 1 BMI	-		<del>-</del>
6	(derivation Clinical only)	Low	Low	Low
	Saranburut, 2017 - Model 2 (derivation		Ι . Τ	
6	Clinical + Limited laboratory tests)	Low	Low	Low
6	Saranburut, 2017 - Model 3 (derivation	Low	Low	Low
6	Clinical + Full laboratory tests) Saranburut, 2017 - Model 1 (validation	Low	Low	Low
6	Clinical only)	Low	Low	Low
	Saranburut, 2017 - Model 2 (validation			
6	Clinical + Limited laboratory tests)	Low	Low	Low
7	Thakkinstian, 2011 (derivation)	Low	Low	Low
	Wen, 2020 - Simple Risk Score			
8		Low	Low	Low
8		Low	Low	Low
	, ,	_	_	
	Clinical + Limited laboratory tests) Thakkinstian, 2011 (derivation)		<del>                                     </del>	
9	Wu, 2016 (derivation)	Low	Low	Low

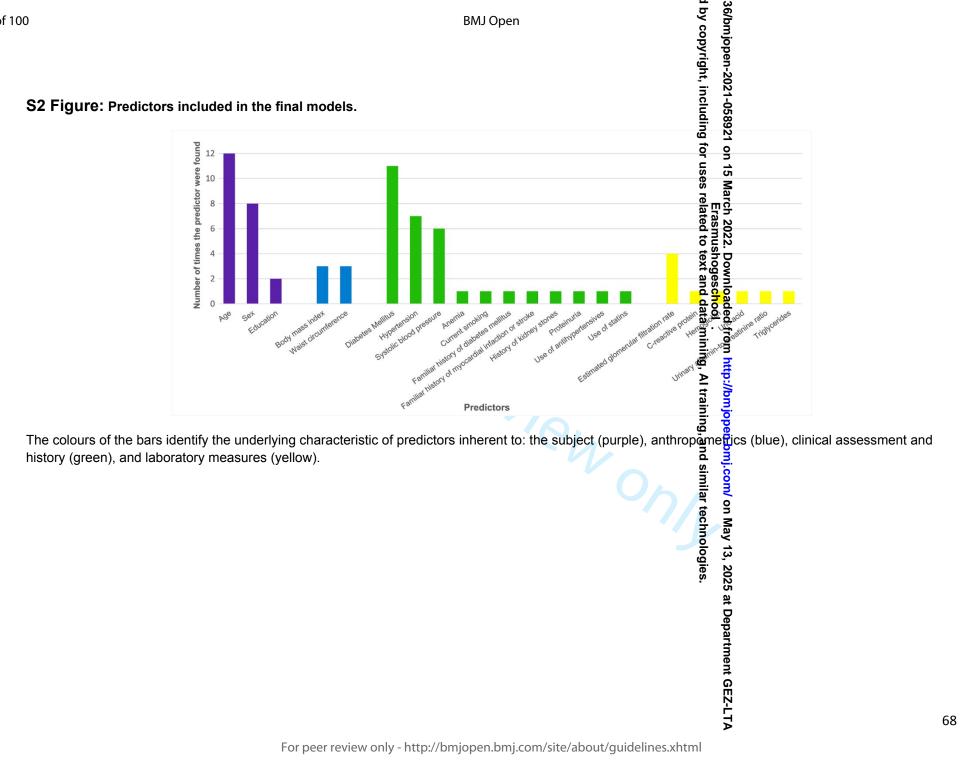
9	Wu, 2016 (val	lidation)	Low	Low	Low
Answer options: Low (low concern for applicability), Hig (High concern for applicability) and Unclear (Unclear concern for					

applicability)

#### S1 Figure: Countries where studies were conducted.



#### **S2** Figure: Predictors included in the final models.



# **BMJ Open**

# A systematic review of diagnostic and prognostic models of chronic kidney disease in low- and middle- income countries

Journal:	BMJ Open
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Complete List of Authors:	Aparcana-Granda, Diego J.; School of Medicine 'Alberto Hurtado', Universidad Peruana Cayetano Heredia, Lima, Peru; CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru Ascencio, Edson J.; School of Medicine 'Alberto Hurtado', Universidad Peruana Cayetano Heredia, Lima, Peru; Health Innovation Laboratory, Institute of Tropical Medicine 'Alexander von Humboldt', Universidad Peruana Cayetano Heredia, Lima, Peru Carrillo Larco, Rodrigo M.; Imperial College London,
<b>Primary Subject Heading</b> :	Epidemiology
Secondary Subject Heading:	Epidemiology, Global health, Renal medicine, Public health
Keywords:	Chronic renal failure < NEPHROLOGY, EPIDEMIOLOGY, PUBLIC HEALTH, NEPHROLOGY

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1	A systematic review of diagnostic and prognostic models of chronic kidney disease in low-
2	and middle- income countries
3	
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5	
6	Diego J. Aparcana-Granda <sup>1,2¶</sup> , Edson J. Ascencio <sup>1,3,4¶</sup> , Rodrigo M. Carrillo-Larco <sup>2,5¶</sup> *
7	
8 9	<sup>1</sup> School of Medicine 'Alberto Hurtado', Universidad Peruana Cayetano Heredia, Lima, Peru
LO L1 L2	<sup>2</sup> CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru
L3 L4 L5	<sup>3</sup> Emerge, Emerging Diseases and Climate Change Research Unit, School of Public Health and Administration, Universidad Peruana Cayetano Heredia, Lima, Peru
16 17 18	<sup>4</sup> Health Innovation Laboratory, Institute of Tropical Medicine 'Alexander von Humboldt', Universidad Peruana Cayetano Heredia, Lima, Peru
19 20 21	<sup>5</sup> Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK
22	*Corresponding author (RMCL)
23	Email: rcarrill@ic.ac.uk
24	
25	These authors contributed equally to this work.
26	*Corresponding author (RMCL)  Email: rcarrill@ic.ac.uk  These authors contributed equally to this work.

Objective: To summarize available chronic kidney disease (CKD) diagnostic and prognostic models in Low- and Middle-Income countries (LMIC)

**Method:** Systematic review (PRISMA guidelines). We searched Medline, EMBASE, Global Health (these three through OVID), Scopus and Web of Science from inception to April 9th, 2021, April 17th, 2021 and April 18th, 2021, respectively. We first screened titles and abstracts, and then studied in detail the selected reports; both phases were conducted by two reviewers independently. We followed the CHARMS recommendations and used the PROBAST for risk of bias assessment.

**Results:** The search retrieved 14,845 results, 11 reports were studied in detail and nine (n= 61,134) were included in the qualitative analysis. The proportion of women in the study population varied between 24.5%-76.6%, and the mean age ranged between 41.8-57.7 years. Prevalence of undiagnosed chronic kidney disease ranged between 1.1%-29.7%. Age, diabetes mellitus and sex were the most common predictors in the diagnostic and prognostic models. Outcome definition varied greatly, mostly consisting of urinary albumin-to-creatinine ratio and estimated glomerular filtration rate. The highest performance metric was the negative predictive value. All studies exhibited high risk of bias, and some had methodological limitations.

**Conclusion:** There is no strong evidence to support the use of a CKD diagnostic or prognostic model throughout LMIC. The development, validation and implementation of risk scores must be a research and public health priority in LMIC to enhance CKD screening to improve timely diagnosis.

**Keywords:** population health; prognosis research; non-communicable diseases

#### Strengths and limitations of this study

#### **Strengths**

- An extensive search was conducted, involving five major databases (Medline, Embase,
   Global Health, Scopus and Web of Science).
- A comprehensive list of available CKD diagnostic and prognostic models and their limitations is provided, which were not previously accounted for in the LMIC population.
- This study adhered to PRISMA, CHARMS and PROBAST guidelines.

#### Limitations

- Meta-analysis was not possible due to the heterogeneity in the measurement of outcomes.
- Additional data sources such as grey literature were not retrieved.



### INTRODUCTION

Chronic kidney disease (CKD) is a condition with a large burden globally. Between 1990 and 2017, the health metrics of CKD showed a bleak profile: mortality, incidence and kidney transplantation rates increased by 3%, 29% and 34%, respectively.¹ CKD led to 1.2 million deaths in 2017 and in the best-case scenario, CKD mortality will increase to 2.2 million deaths and become the 5<sup>th</sup> cause of years of life lost (YLL) by 2040.² CKD reveals disparities between low- and middle-income countries (LMIC) and high-income countries (HIC). In the period 1990-2016, the age-standardised disability-adjusted life-years (DALY) due to CKD was the highest in LMIC,³ where they need to optimize CKD early diagnosis.

Risk scores are a cost-effective alternative for CKD screening and early diagnosis.<sup>4</sup> These equations require less resources and contribute to decision making,<sup>5</sup> and allow screening of large populations.<sup>4</sup> Many of the available CKD risk scores have been developed in HIC,<sup>6-8</sup> and they may not be used in LMIC without recalibration to secure accurate predictions. How many CKD risk scores there are for LMIC, and what their strengths and limitations are, remains largely unknown.<sup>9 10</sup> This limits our knowledge of what tools there are to enhance CKD screening in LMIC. Similarly, this lack of evidence prevents planning research to overcome the limitations of available models. To fill these gaps and to inform CKD screening strategies in LMIC, we summarized available CKD diagnostic and prognostic models in LMIC.

### **METHODS**

### Protocol and registration

This systematic review and critical appraisal of the scientific literature was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (PRISMA) statement<sup>11</sup> (S1 Table). Protocol is available elsewhere<sup>12</sup> and in the S1 Text. We followed the CHecklist for critical Appraisal and data extraction for systematic Reviews of prediction Modelling Studies (CHARMS) guidelines.<sup>13 14</sup>

### Information sources

We searched Medline, EMBASE, Global Health (these three through OVID), Scopus and Web of Science from inception to April 9<sup>th</sup>, 2021, April 17<sup>th</sup>, 2021 and April 18<sup>th</sup>, 2021, respectively. The

## Eligibility criteria

 We sought models which assessed the current CKD status (i.e., diagnostic) or future CKD risk (i.e., prognostic), aiming to inform physicians, researchers, and the general population (Table 1). Reports could include model derivation, external validation, or both. The target population was adults (≥18 years) in LMIC according to The World Bank.<sup>15</sup>

# Study selection

Reports were selected if the study population included people who were from and currently living in LMIC. Cross-sectional (diagnostic models) and longitudinal studies (prognostic models) with a random sample of the general population were included. The outcome was CKD based on a laboratory or imaging test (isolated or in combination with self-reported diagnosis): urine albumin-creatinine ratio, urine protein-creatinine ratio, albumin excretion ratio, urine sediment, kidney images, kidney biopsy or the estimated glomerular filtration rate (eGFR).<sup>12</sup>

Reports had to present the development and/or validation of a multivariable model. On the other hand, reports with LMIC populations outside LMIC, or those including foreigners living in LMIC, were excluded. Reports that only studied people with underlying conditions (e.g., patients with diabetes), people with a specific risk factor (e.g., alcohol consumption), or a hospital-based population, were excluded. We also excluded models that were developed using machine learning techniques due to their usually poor report of performance metrics, as noted from previous reviews.<sup>16 17</sup> To overcome this limitation, CHARMS and PROBAST tools are currently being adapted to machine learning methodology but are yet to be published.<sup>18</sup>

# **Data collation**

We used EndNote20 and Rayyan<sup>19</sup> to remove duplicates from the search results. We used Rayyan<sup>19</sup> to screen titles and abstracts by two reviewers independently (DJA-G and EJA); discrepancies were solved by consensus. Two reviewers independently (DJA-G and EJA) studied the full length of the reports selected in the screening phase; discrepancies were solved by consensus. If consensus was not reached, a third party was consulted (RMC-L). A data extraction form based on the CHARMS guidelines<sup>14</sup> was developed and not modified during data collation. Data was extracted as presented

 in the original reports by two reviewers independently (DJA-G and EJA); discrepancies were solved by consensus.

### Risk of bias of individual studies

We used the PROBAST (Prediction model Risk of Bias ASsessment Tool) to assess the risk of bias of diagnostic and prognostic models.<sup>20</sup> <sup>21</sup> Two reviewers (EJA and DJA-G) independently ascertained the risk of bias of individual reports; discrepancies were solved by consensus or a third party (RMC-L).

# Synthesis of results

A qualitative synthesis was conducted whereby the characteristics of the selected models was comprehensively described.<sup>12</sup> Quantitative analysis (meta-analysis) was not conducted because the selected models used different predictors and they had different outcome definitions.

### **Ethics**

This review was deemed as a low risk because human subjects were not directly involved. The funder did not have any role in the conception, conduction, results interpretation, and drafting of this work.

Results and opinions expressed in the article are entirely the authors.

### Patient and public involvement

No patient involved.

### **RESULTS**

### Reports selection

The search yielded 14,845 reports. After removing duplicates (1,462 articles), we screened 13,383 titles and abstracts. Then, 11 reports were selected, one of them was not available as full-text,<sup>22</sup> and the rest (10 articles) were studied in detail. We excluded one report because the study population was not randomly selected,<sup>23</sup> and another report because it was conducted in a HIC.<sup>24</sup> Additionally, one report was identified by reference searching.<sup>25</sup> Finally, nine reports (n=61,134) were included in the qualitative synthesis (Figure 1).

# General characteristics of the selected reports

Original reports were from Iran,<sup>26</sup> India,<sup>27</sup> Peru, <sup>28</sup> South Africa, <sup>25</sup> two from China<sup>29 30</sup> and three from Thailand<sup>31-33</sup> (S1 Figure). All studies were developed on community-based populations with random sampling (S3 Table).

The sample size analysed to derive the diagnostic models ranged from 2,368<sup>28</sup> to 14,374 people,<sup>30</sup> and from 902<sup>25</sup> to 4,940<sup>27</sup> for the validation models. The mean age of participants in the derivation models varied from 44.9 to 57.7 years, and the proportion of male subjects ranged from 46.8% to 70.5%.<sup>27-30</sup> <sup>32</sup> <sup>33</sup> The mean age of participants in the validation models varied from 41.8 to 57.1 years, and the proportion of male subjects ranged from 23.4% to 75.5%<sup>25-28</sup> <sup>30-32</sup> (Table 2; S3 Table).

The number of CKD cases varied greatly in the derivation models, from 81<sup>28</sup> to 947;<sup>27</sup> the corresponding numbers in the validation models were 27<sup>32</sup> and 1,359<sup>26</sup>. Of note, number of CKD cases could not be extracted from the validation work by Bradshaw *et al*<sup>27</sup>. The ratio of outcome events per number of candidate predictors in the derivation models ranged from 2.3<sup>28</sup> to 135.3<sup>27</sup>. This ratio could not be calculated for the derivation models by Wen *et al*<sup>29</sup> and Wu *et al*<sup>30</sup>. Across all reports, missing data were handled by conducting a complete-case analysis;<sup>25-32</sup> this information was not available in the study by Thakkinstian's *et al*<sup>33</sup> (Table 2; S3 Table).

# What has been done?

In 2011, Thakkinstian *et al* derived one model using cross-sectional data.<sup>33</sup> In 2015, Mogueo *et al* used cross-sectional data to validate two models that were previously developed in South Korea and Thailand using two different outcome definitions for each model, i.e., they provided estimates for four model validations.<sup>25</sup> In 2016, Wu *et al* used cross-sectional data to derive and validate one model, i.e., they provided estimates for two models (one derivation and one validation).<sup>30</sup> In 2017, Carrillo-Larco *et al* used cross-sectional data to derive and validate two models, i.e., they provided estimates for four models (two derivations and two validations).<sup>28</sup> In 2017, Saranburut *et al* prospectively validated the Framingham Heart Study risk score on a cohort using two different outcome definitions, i.e., they provided estimates for two model validations.<sup>31</sup> In 2017, Saranburut *et al* prospectively developed four models and validated two of them using cohort data, i.e., they provided estimates for six models (four derivations and two validations).<sup>32</sup> In 2019, Bradshaw *et al* used cross-sectional data to derive four models, one of them was validated on two populations (rural and urban), i.e. they provided estimates

for six models (four derivations and two validations).<sup>27</sup> In 2020, Asgari and colleagues prospectively validated a model from the Netherlands for 6- and 9-years CKD prediction, i.e. they provided estimates for two model validations.<sup>26</sup> In 2020, Wen *et al* prospectively derived two models.<sup>29</sup> Overall, fourteen models were derived and fifteen underwent validation (hence the 29 rows in Table 4).

### **Outcome ascertainment**

Across all reports, CKD was defined as eGFR <60 mL/min/1.73m<sup>2</sup> <sup>25-33</sup> assessed by either the Modification of Diet Renal Disease (MDRD) formula<sup>25</sup> <sup>26</sup> <sup>28</sup> <sup>29</sup> <sup>31</sup> <sup>33</sup> or the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula.<sup>27</sup> <sup>30-32</sup> In addition to the eGFR assessment, Bradshaw *et al*<sup>27</sup> and Wen *et al*<sup>29</sup> defined CKD as a urinary albumin-to-creatinine ratio (UACR) ≥30 mg/g. Mogueo *et al* validations also considered CKD as any nephropathy including stages I to V of the "Kidney Disease: Improving Global Outcomes (KDIGO)" classification.<sup>25</sup> Thakkinstian *et al*, also considered CKD as eGFR ≥60 mL/min/1.73m<sup>2</sup> if it had haematuria or UACR ≥30 mg/g <sup>33</sup> (Table 2).

# **Predictors and modelling**

Logistic regression analysis was conducted in all derivation models.<sup>27-30</sup> <sup>32</sup> <sup>33</sup> Selection of the final predictors was based on modelling techniques: backward<sup>27</sup> <sup>28</sup> and forward selection<sup>29</sup> <sup>30</sup> <sup>32</sup> <sup>33</sup> (S3 Table). All studies categorized numerical variables. The most frequent predictors included in the models were: age, diabetes mellitus and sex (S2 Figure).

### Model performance

All studies reported calibration and discrimination metrics, except for the validations by Bradshaw *et al*<sup>27</sup> and Carrillo-Larco *et al*<sup>28</sup> (S3 Table). Regarding discrimination metrics, the area under the Receiver Operating Characteristic (ROC) curve and C-statistic were over 63%<sup>31</sup> and 70%,<sup>27</sup> respectively. Among all studies, sensitivity ranged from 56.8%<sup>29</sup> to 84.0%,<sup>25</sup> specificity ranged from 65.1%<sup>29</sup> to 86.3%,<sup>30</sup> positive predictive value (PPV) ranged from 8.8%<sup>28</sup> to 33.8%,<sup>29</sup> and negative predictive value (NPV) ranged from 89.4%<sup>29</sup> to 99.1%.<sup>28</sup> The NPV was the best metric, consistently above 89.4% (Table 3).

### Risk of bias

 All studies showed a high risk of bias due to insufficient or inadequate analytical reporting. The flaw regarding the analysis criteria can be explained by how original reports handled missing data and predictors categorization. The participants and predictors criteria had low risk of bias in most of the reports. Most of the individual reports demonstrated an inappropriate evaluation of performance metrics.<sup>26</sup> <sup>28</sup> <sup>33</sup> Low applicability concern was noted (Table 4; S4Table).

### **DISCUSSION**

# Main findings

This systematic review summarized all available risk scores for CKD in LMIC. In so doing, we provided the most comprehensive list of CKD risk scores to enhance primary prevention and early diagnosis of CKD in LMIC. Although the available models had acceptable discrimination metrics and, when available, acceptable calibration metrics, these models had serious methodological limitations such as a reduced number of outcome events. The best performance metric across risk scores was the negative predictive value. Overall, CKD risk prediction tools in LMIC need rigorous development and validation so that they can be incorporated into clinical practice and interventions. The available evidence would not support using any of the available CKD risk scores across LMIC.

## Limitations of the review

We did not search grey literature. We argue that this limitation would not substantially change our results because these sources are most likely not to have included a random sample of the general population and are likely to have included a small sample size with few outcome events. That is, we would not expect to find a report in the grey literature with a much better methodology than that of the studies herein summarised.

# Limitations of the selected reports

Several LMIC do not have a CKD risk score, particularly countries in Central America and Oceania.

This should encourage public health officers and researchers to develop CKD prediction models.

They could conduct new epidemiological studies or leverage on available health surveys with kidney biomarkers. These models could have pragmatic and direct applications in clinical medicine, by providing a tool for early identification of CKD cases. Similarly, these models could inform public

health interventions and planning, by providing a tool to quantify the size of the population likely to have or to develop CKD.

Clinical guidelines state that CKD is defined as a sustained structural or functional kidney damage for ≥3 months.<sup>34</sup> In the studies herein summarised, CKD was defined at one point in time. Future work could expand the definition of CKD to also incorporate the lapse during which the patient had kidney damage. In addition, different procedures were used to define CKD including eGFR, proteinuria, and UACR. Even amongst those studies in which CKD was defined with eGFR, they used different equations to compute the eGFR. Researchers and practitioners in LMIC could agree on the best and most pragmatic as well as cost-effective definition of CKD, so that future models could use this definition. This would improve the comparability and extrapolability of the models.

All reports in which a new CKD risk score was developed selected the predictors through univariate analyses, <sup>27-30</sup> <sup>32</sup> <sup>33</sup> which is not be the best approach to choose predictors. <sup>35-37</sup> Ideally, predictors should be selected based on expert knowledge, or amongst those with the strongest association evidence with CKD. In a similar vein, predictors selection should be guided by the target population. For example, CKD prediction models for populations in LMIC should prioritize simple biomarkers or inexpensive clinical evaluations (e.g., blood pressure). In this way, the risk score is likely to be used in clinical practice in resource-limited settings. Another relevant methodological limitation was how the original reports handled missing data. To the extent possible, multiple imputation should be implemented to maximize available data and to avoid potential bias by studying only observations with complete information.

Calibration assesses the degree of agreement between actual outcomes and model prediction, whereas discrimination is the ability of the model to differentiate people with and without the outcome. Calibration metrics need to be consistently reported and should inform the direction of the miscalibration. Most of the studies used the Hosmer-Lemeshow X² test as the calibration metric. Unfortunately, this test does not inform on whether the model prediction is overestimating or underestimating the observed risk; calibration plots are a useful alternative. Therefore, it was not always possible to reach strong conclusions about the performance of the available models. Prognostic models should be updated before they can be applied in a new target population. This process is known as recalibration. Because we found a handful of prognostic models in some

# Clinical and public health relevance

The Latin American Society of Nephrology and Hypertension (Sociedad Latinoamericana de Nefrología e Hipertensión - SLANH) recommends to annually screen for CKD with several markers: blood pressure, serum creatinine, proteinuria and urinalysis.38 The South African Renal Society (SARS) guidelines also recommend CKD screening annually, yet they focus on high-risk populations: people with diabetes, hypertension, or HIV.<sup>39</sup> This recommendation is endorsed by the Asian Forum for Chronic Kidney Disease Initiatives (AFCKDI), extending it to individuals ≥65 years, people consuming nephrotoxic substances, and those with family history of CKD and past history of acute kidney injury. 40 Although it seems reasonable to screen people with risk factors such as hypertension and diabetes, this approach may miss a large proportion of the high-risk population because they could be unaware of their condition. 41 42 In this case, risk scores could be useful because they can be applied to large populations regardless of whether they are aware of their hypertension or diabetes status. Unfortunately, our work would not support nor encourage the inclusion of available risk scores for CKD in clinical guidelines in LMIC. Instead, our results urgently call to improve risk prediction research in LMIC. Therefore, CKD risk scores could be included into clinical practice to identify highrisk individuals and to inform the patient's management plan as is the case in other fields such as cardiovascular primary prevention.

# Conclusions

This systematic review of diagnostic and prognostic models of CKD did not find conclusive evidence to recommend the use of a single CKD score across LMIC. Nonetheless, we identified relevant efforts in Iran, India, Peru, South Africa, China and Thailand; these models would require further external validation before they can be applied in other LMIC. We encourage researchers and practitioners to develop and validate CKD risk scores, which are cost-efficient tools to early identify CKD prevalent and incident cases so that they can receive timely treatment.

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<u>2</u> 3 1	283	Contributors:
5	284	RMC-L, DJA-G and EJA conceived the idea. RMC-L, DJA-G and EJA conducted the search. DJA-G
7 3 9	285	and EJA wrote the manuscript. All authors approved the submitted version.
10 11	286	Carrillo Larco, Rodrigo M. (proxy) (contact); Aparcana-Granda, Diego J.; Ascencio, Edson J.
12 13 14 15	287	
16 17	288	Funding: RMC-L is supported by a Wellcome Trust International Training Fellowship
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20 21 22	290	Competing interests: None declared.
23 24 25	291	Patient consent for publication: Not required.
26 27	292	Data availability statement: Data sharing not applicable as no data sets generated for this study.
28 29	293	Given the nature of systematic reviews, the data set generated and analysed for the current study is
30 31 32 33 34 35 36 37 38 39 40 41 41	294	already available. All studies analysed for the present review are referenced for readers.
11 12 13 14		

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#### Table 1. CHARMS criteria to define research question and strategy.

Concert	Cuitouio
Concept	Criteria
Prognostic or diagnostic?	Both - this review focused on diagnostic and
	prognostic risk scores for chronic kidney
Casas	disease (CKD)
Scope	Diagnostic/prognostic models to inform physicians, researchers and the general
	population whether they are likely to have CKD
	(i.e., diagnostic) or will be likely to have CKD (i.e.,
	prognostic)
Type of prediction modelling studies	Diagnostic/prognostic models with
· · · · · · · · · · · · · · · · · · ·	external validation
	<ul> <li>Diagnostic/prognostic models without external validation</li> </ul>
	Diagnostic/prognostic models validation
Target population to whom the prediction model	General adult population in Low- and Middle-
applies	Income Countries (LMIC). No age or gender
	restrictions
Outcome to be predicted	CKD (diagnostic or prognostic)
Time span of prediction	Any, prognostic models will not be
	included/excluded based on the prediction time span
Intended moment of using the model	Diagnostic/prognostic models to be used in
interface moment of using the model	asymptomatic adults of LMIC to ascertain current
	CKD status or future risk of developing CKD.
	These models could be used for screening,
	treatment allocation in primary prevention, or
	research purposes
Based on the CHARMS checklist.14	

#### Table 2. General characteristics.

		BMJ Open						36/bmjo		Page 18 of
1 2 3 4	431	Table 2. Gener	al characte	eristics.			BMJ Open  Outcome details	36/bmjopen-2021-05892 Boseline sample size		
5 6 7 8	Nº of report	Study	Country	Outcome prevalence (%)	Mean age (years)	Men (%)	Outcome details	ğ   σ	Number of outcome events	Outcome events per candidate predictors
9 10 11 12 13	1	Asgari <i>et al</i> , 2020	Iran	6-years validation: 22.08 9-years validation: 41.94	6-years validation: 46.02 9-years validation: NI	6-years validation: 40.1 9-years validation: 40.6	CKD was defined as eGFR <60 mL/min/1.73 m², provided by the MDRD formula	6-years  Galidation: 3,270  Bayes  9-years  9-years  Malidation: 3,240	6-years validation: 722  9-years validation: 1,359	For every model validation: n/a
14 15 16 17 18 19 20 21 22 23	2	Bradshaw et al, 2019	India	For every model derivation: 10.89 For every model validation: NI	For every model derivation: 44.9 For every model validation: NI	For every model derivation: 46.8 For every model validation: NI	CKD was defined as an eGFR rate <60 mL/min/1.73 m <sup>2</sup> (estimated with the CKD-EPI equation) or UACR ≥30 mg/g  CKD was defined as eGFR <60 mL/min/1.73 m <sup>2</sup> , provided by the MDRD formula	de d	For every model derivation: 947 For every model validation: NI	Model 1 derivation: 31.6  Model 2 derivation: 41.2  Model 3a derivation: 135.3  Model 3b derivation: 118.4  For every model validation: n/a
24 25 26 27 28 29 30 31	3	Carrillo-Larco <i>et al</i> , 2017	Peru	For every model derivation: 3.42 For every model validation: 5.41	For every model derivation: 57.7 For every model validation: 57.1	For every model derivation: 49.4 For every model validation: 47.7	CKD was defined as eGFR <60 mL/min/1.73 m², provided by the MDRD formula	Serivation: 2,368 Sor every model Serivation: 1,459 Solution: 1,459	For every model derivation: 81 For every model validation: 79	Complete model derivation: 2.25  Lab-free model derivation: 3.1  For every model validation: n/a
32 33 34 35 36 37 38 39	4	Mogueo <i>et al</i> , 2015	South Africa	For every eGFR model validation: 28.71  For every eGFR or proteinuria model validation: 29.71	For every model validation: 55	For every model validation: 23.4	CKD was defined as eGFR <60 mL/min/1.73 m², provided by the 4-variable MDRD formula	្រុ	For every eGFR model validation: 259  For every eGFR or proteinuria model validation: 268	For every model validation: n/a

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1 2									en-2021		
3 4	5	Saranburut <i>et al</i> , 2017 - Framingham	Thailand	MDRD model validation: 10.37	MDRD model validation: 54.6	MDRD model validation: 70.8	MDRD model validation: CKD was defined as eGFR <6 mL/min/1.73 m², provided by the MDRD formula	dudir	MDRD model didation: 2,141 S EKD-EPI model	MDRD model validation: 222	For every model
5 6 7	Ü	Heart Study	Thanana	CKD-EPI model validation: 10.01	CKD-EPI model validation: 54.7	CKD-EPI model validation: 71.5	CKD-EPI model validation: CKD was defined as eGF <a href="#">&lt;60 mL/min/1.73 m²</a> , provided by the CKD-EPI equation	2   <u>-</u>	alidation: 2,328	CKD-EPI model validation: 233	validation: n/a
8									<del>2</del>		Model 1 derivation: 18.1
10 11		Consolium 4 of of		For every model derivation: 8.51	For every model derivation: 51.3	For every model derivation: 70.5	CKD was defined as a preserved GFR (eGFR ≥60 mL/min/1.73m²) at baseline and subsequently develope	Erasm Slated	Ear avery model	For every model derivation: 271	Model 1 BMI derivation: 18.1
12 13	6	Saranburut <i>et al</i> , 2017	Thailand	For every model validation: 1.94	For every model	For every model	decreased GFR (eGFR <60 mL/min/1.73m²) at the 10-i year follow-up, provided by the Two-level Race Variable	te de	S	For every model validation: 27	Model 3 derivation: 12.3
14 15 16					validation: 45.6	validation: 70.5		eschool and data			For every validation model: n/a
17 18 19						664	CKD was defined as a combination of stages I to V. Ck stage I & II was defined as eGFR ≥90 and eGFR 60-8	3			
20 21 22	7	Thakkinstian <i>et al</i> , 2011	Thailand	18.10	45.2	45.5	ml/min/1.73 m², respectively; with haematuria or UACR ≥30 mg/g. CKD stage III, IV, and V was defined as eGFF 30-59, 15-29, and <15 ml/min/1.73 m², respectively; regardless of kidney damage (eGFR was calculated usin the MDRD formula)	≥	3,459	626	16.9
23 24 25 26	8	Wen <i>et al</i> , 2020	China	For every derivation model: 18.06	For every derivation model: 50	For every derivation model: 44.7	CKD was defined as an eGFR rate <60 mL/min/1.73 m (assessed with the modified Chinese MDRD equation) d UACR ≥30 mg/g	a. and	For every lerivation model:	For every derivation model: 590	For every derivation model: NI
27 28	0	We -4 -1 2040	Ohina	Model derivation: 2.05	Model derivation: 45.3	Model derivation: 56.7	CKD was defined as eGFR <60 mL/min/1.73 m², provide	<u> </u>	odel derivation: 14,374	Model derivation: 294	Model derivation: NI
29 30	9	Wu <i>et al</i> , 2016	China	Model validation: 1.10	Model validation: 41.8	Model validation: 63.7		<u>e</u>	dodel validation:	Model validation: 48	Model validation: n/a
31   32	432	CKD, chronic ki	dney disea	⊥ ase; CKD-EPI, chro	nic kidney dis	ease epidemic	logy collaboration; eGFR, estimated glorf		ਤ ar filtration rat	e; GFR, glomeru	lar
33 34	433	filtration rate; KI	DIGO, MDI	RD, modification o	f diet renal dise	ease; n/a, not a	؛ applicable; NI, no information; UACR, urin	ary <u></u>	<del>-</del>	eatinine ratio.	
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N°	Study	Discrimination (%)	Constitution Const	ft⊵ation measures ⊙
1	Association 2020	6-years validation: AUC (95% CI) for final intercept adjusted model = Male: 76 (72-79) and Female: 71 (69-73)		25: sensitivity=72.7%; specificity=67.6%. For women third th
'	Asgari et al, 2020	9-years validation: AUC (95% CI) for final intercept adjusted model = Male: 71 (67-74) and Female: 70 (68-73)	9-years validation: For men at a cut இள்ற at a cut-off of 23	25: sensitivity=64.5%; specificity=69.5%. For women stitivity=56.9%; specificity=76.6%
				Sensitivity=72%; specificity=72%; positive predictive
		Model 1 derivation: C-statistic (95% CI) = 79 (78-81)	T Q	tive predictive value=96%  ensitivity=68%; specificity=67%; positive predictive
		Model 2 derivation: C-statistic (95% CI) = 73 (72-75)	value=20%	tive predictive value=95%
2	Bradshaw <i>et al</i> , 2019	Model 3a derivation: C-statistic (95% CI) = 77 (75-79)		e sensitivity=71%; specificity=70%; positive predictive tive predictive value=95%
		Model 3b derivation: C-statistic (95% CI) = 77 (76-79)  Urban validation: C-statistic (95% CI) = 74 (73-74)	Model 3b derivation: At a cut-off of 0.09 value=22%	sensitivity=71%; specificity=70%; positive predictive settive predictive value=95%
		Rural validation: C-statistic (95% CI) = 70 (69-71)	Urb <mark>a</mark> n n	ਰ ਲੁdel validation: NI
			Ruigal m	odel validation: NI
			predictive value=8.8%; negative predective	of 2: sensitivity=82.5%; specificity=70.0%; positive value=99.1%; likelihood ratio positive=2.8; likelihood negative=0.3
		Complete model derivation: AUC = 76.2		of 2: sensitivity=80%; specificity=72%; positive value=99%; likelihood ratio positive=2.9; likelihood
3	Carrillo-Larco et al,	Lab-free model derivation: AUC = 76		ந்negative=0.3
	2017	Complete model validation: AUC = 70	Complete model validation: At a Eut-o	Gof 2: sensitivity=70.5%; specificity=69.1%; positive
		Lab-free model validation: AUC = 70	predictive value=11.4%; negative predictive rati	value=97.6%; likelihood ratio positive=2.3; likelihood negative=0.4
			predictive value=11.6%; negative predictiv	graph 2: sensitivity=70.5%; specificity=69.7%; positive value=97.7%; likelihood ratio positive=2.3; likelihood regative=0.4
				t <del>0</del>

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		South Korean eGFR model validation: C-statistic (95% CI) = 79.7 (76.5-82.9)	South Korean eGFR model validation: South Korean eGFR model validation: South Korean eGFR model validation in the control of 0.30: sensitivity=82%; specificity=67%
		Thai eGFR model validation: C-statistic (95% CI) = 76 (72.6-79.3)	Thai eGFR model validation 🖰 ta 🛱 t-off of 0.31: sensitivity=73%; specificity=72%
4	Mogueo <i>et al</i> , 2015	South Korean eGFR or proteinuria model validation: C-statistic (95% CI) = 81.1 (78.0-84.2)	South Korean eGFR or proteinuria model validation: At a cut-off of 0.31: sensitivity=84%; specificity=68%
		Thai eGFR or proteinuria model validation: C-statistic (95% CI) = 77.2 (73.9-80.5)	Thai eGFR or proteinuria moganizalidation: At a cut-off of 0.32: sensitivity=74%;
	Saranburut et al, 2017 -	MDRD model validation: AUC (95% CI) = 69 (66-73)	MD最近noodel validation: NI
5	Framingham Heart Study	CKD-EPI model validation: AUC (95% CI) = 63 (57-65)	CKD로에 화odel validation: NI
		Model 1 derivation: AUC (95% CI) = 72 (69-75)	ကြီးဝင်ကို derivation: NI
		Model 1 BMI derivation: AUC (95% CI) = 72 (69-75)	Mogel 198MI derivation: NI
6	Saranburut <i>et al</i> , 2017 - Model 1 (derivation Clinical only)	<b>Model 2 derivation:</b> AUC (95% CI) = 79 (76-82)	Modent derivation: NI
		Model 3 derivation: AUC (95% CI) = 80 (77-82)	derivation: NI
		Model 1 validation: AUC (95% CI) = 66 (55-78)	wooden validation: NI
		<b>Model 2 validation:</b> AUC (95% CI) = 88 (80-95)	Mode 2 validation: NI
7	Thakkinstian <i>et al</i> , 2011 (derivation)	C-statistic of internal validation = 74.1	At a cut-off of sepsitivity=76%; specificity=69%
			Simple model derivation: At a cut off 41: sensitivity=70.5%; specificity=65.1%; positive predictive value=29.8%; negative predictive value=91.3%; likelihood ratio positive=2.0; likelihood
	Wen <i>et al</i> , 2020 -	Simple model derivation: AUC (95% CI) = 71.7 (68.9-74.4)	predictive value-29.6%, fregative predictive value-91.5%, fixelificou ratio positive-2.0, fixelificou
8	Simple Risk Score (derivation)	Best-fit model derivation: AUC (95% CI) = 72.1 (69.3-74.8)	Best-fit model derivation: At a cut off 824: sensitivity=56.8%; specificity=76.6%; positive
			predictive value=33.8%; negative predictive value=89.4%; likelihood ratio positive=2.4 likelihood ratio positive=0.6
	Wu <i>et al</i> , 2016	Model derivation: AUC (95% CI) = 89.4 (86.1-92.6)	Model derivation: At a cut-of of 36: sensitivity=82%; specificity=86.3%
9	(derivation)	<b>Model validation:</b> AUC (95% CI) = 88.0 (82.9-93.1)	Model validation: NI
35 A	UC, area under the cu	rve; CI, confident interval; NI, no information.	GEZ

#### Table 4: Risk of bias assessment of individual diagnostic/prediction models

Table 4: Risk of bias assessment of indiv	vidual diagn	ostic/predicti	BMJ Ope	n		d by copyright, including	36/bm jopen-2021-0589			Pag	
		·	Risk of Bias	(RoB)		gnibr	Spplicability			Overall	
Study	Objective	Participants	Predictors	Outcome	Analysis	Participa <u>at</u> s	Predictors	Outcome	RoB	Applicability	
Asgari <i>et al</i> , 2020 European Risk Assessment tool (6-years)	Validation	+	+	?	-	Eras es relate +	P	+	-	+	
Asgari et al, 2020 European Risk Assessment tool (9-years)	Validation	+	+	?	-	smushood to text	+	+	-	+	
Bradshaw <i>et al</i> , 2019 - Model 1	Derivation	+	+	?	-	gescl t and +	+ +	+	-	+	
Bradshaw <i>et al</i> , 2019 - Model 2	Derivation	<b>D</b>	+	?	-	hool data +	<del>)</del> +	+	-	+	
Bradshaw <i>et al</i> , 2019 - Model 3a	Derivation	40	+	?	-		<del>f</del> +	+	-	+	
Bradshaw et al, 2019 - Model 3b	Derivation	+	<b>/</b> +	?	-	+ 19,	+	+	-	+	
Bradshaw et al, 2019 - Model 3a (CARRS-I urban)	Validation	+	+	?	-	<u>A</u> tra	+	+	-	+	
Bradshaw et al, 2019 - Model 3a (UDAY rural)	Validation	+	+	?	-	training,	<u>P.                                    </u>	+	-	+	
Carrillo-Larco et al, 2017 - CRONICAS-CKD (complete)	Derivation	+	+	+	1	and +	+ i.	+	-	+	
Carrillo-Larco et al, 2017 - CRONICAS-CKD (lab- free)	Derivation	+	+	+	.0	similar tec +	+ op	+	-	+	
Carrillo-Larco <i>et al</i> , 2017 - CRONICAS-CKD (complete)	Validation	+	+	+	-	hnologies.	+	+	-	+	
Carrillo-Larco et al, 2017 - CRONICAS-CKD (lab- free)	Validation	+	+	+	-		+ 025 24	+	-	+	
Mogueo et al, 2015 – South Korean model (eGFR)	Validation	+	+	?	-		+	+	-	+	
Mogueo et al, 2015 - Thai model (eGFR)	Validation	+	+	?	-	+	# # #	+	-	+	
Mogueo et al, 2015 – South Korean model (eGFR or	Validation	+	+	?	-	+	+ G E S	+	-	+	

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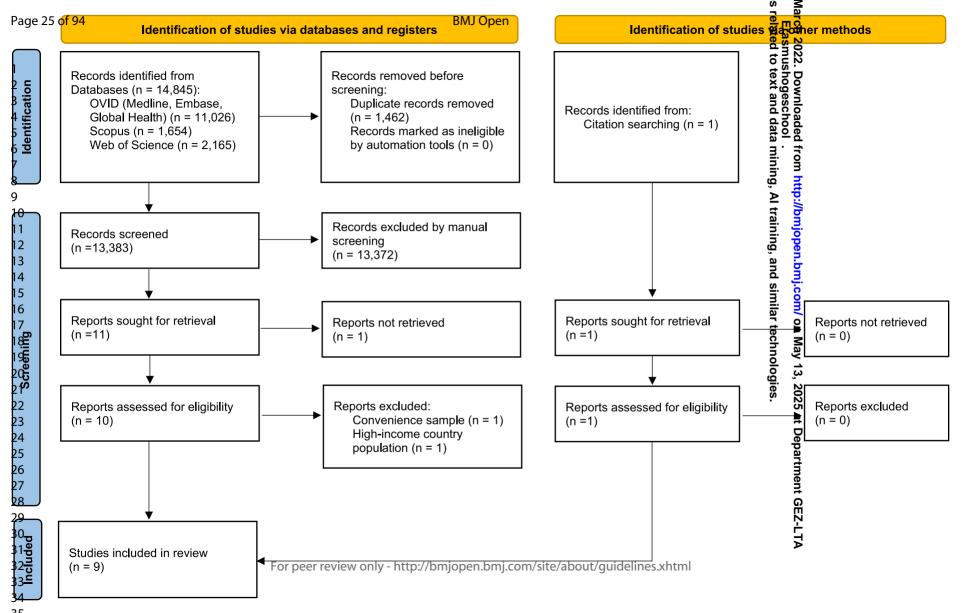
			BMJ Oper	1		by copyright, including for	+ 36/bm jopen-2021 <del>-058\$21</del>			
proteinuria)						ıcludi	1-058			
Mogueo <i>et al</i> , 2015 - Thai model (eGFR or proteinuria)	Validation	+	+	?	-	for	<b>9</b>	+	-	+
Saranburut <i>et al</i> , 2017 - Framingham Heart Study (MDRD)	Validation	+	+	?	-	Erasm uses related : + +	+ + Marc	+	-	+
Saranburut <i>et al</i> , 2017 - Framingham Heart Study (CKD-EPI)	Validation	+	+	?	-	6 5	+ + 2022.	+	-	+
Saranburut et al, 2017 - Model 1 (Clinical only)	Derivation	+	+	?	-	hog +	₽ '	+	-	+
Saranburut <i>et al</i> , 2017 - Model 1 BMI (Clinical only)	Derivation	+	+	?	-	+ <b>n</b> s	<del>P</del> +	+	-	+
Saranburut <i>et al</i> , 2017 - Model 2 (Clinical + Limited laboratory tests)	Derivation	-GO	+	?	-	I data mining,	ed fron	+	-	+
Saranburut <i>et al</i> , 2017 - Model 3 (Clinical + Full laboratory tests)	Derivation	+	/	?	-	ng,	+ +	+	-	+
Saranburut et al, 2017 - Model 1 (Clinical only)	Validation	+	+	?	-	Al trainir	<del>-</del> +	+	-	+
Saranburut <i>et al</i> , 2017 - Model 2 (Clinical + Limited laboratory tests)	Validation	+	+	?	1	ig, and	+ + +	+	-	+
Thakkinstian <i>et al</i> , 2011	Derivation	+	+	?		+ <u>si</u>	+	+	-	+
Wen et al, 2020 - Simple Risk Score	Derivation	+	+	?	-	similar tec	<b>9</b> +	+	1 - 1	+
Wen et al, 2020 - Best-fit Risk Score	Derivation	+	+	?	-	t +	<b>May</b> +	+	1 - 1	+
Wu <i>et al</i> , 2016	Derivation	+	+	?	-	. 4	<del>13</del> + 20	+	1 - 1	+
Wu <i>et al</i> , 2016	Validation	+	+	?	-	+ .	100 57 + 80	+	-	+

PROBAST = Prediction model Risk of Bias ASsessment Tool;<sup>20 21</sup> RoB = risk of bias. + indicates low RoB/low concern Regarding applicability; – indicates high RoB/high concern regarding applicability; and ? indicates unclear RoB/unclear concern regarding applicability.

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439	FIGURES
440	Figure 1. PRISMA 2020 flow diagram.
441	SUPPLEMENTARY MATERIAL
442	S1 Text. Protocol.
443	S1 Table. PRISMA 2020 checklist.
444	S2 Table. Search terms.
445	S3 Table. Data extraction form.
446	S4 Table. Risk of bias and applicability
447	S1 Figure. Countries where studies were conducted. LMIC that developed and/or validated models
448	included in this review (Green). Moreover, Asgari et al,26 Mogueo et al25 and Saranburut et al31 validated
449	risk models that were originally derivated in the Netherlands, South Korea and the United States,
450	respectively (Blue).
451	S2 Figure. Predictors included in the final models. The colours of the bars identify the underlying
452	characteristic of predictors inherent to: the subject (purple), anthropometrics (blue), clinical assessment
453	and history (green), and laboratory measures (yellow).



. A systematic review of diagnostic and prognostic models of Chronic kidney disease in Lowand Middle- Income Countries



S1 Text: Protocol (also available at https://doi.org/10.1101/202	1.04.24.21256041
S1 Table: PRISMA Checklist	
S2 Table: Search terms	
S2.1 Table: Embase, Medline and Global Health (OVID)	
S2.2 Table: SCOPUS	
S2.3 Table: WEB OF SCIENCE	
S3 Table: Data extraction form (by chapters)	
S3.1 Table: Source of data and participants	
S3.2 Table:: Outcome	
S3.3 Table: Candidate predictors	
S3.4 Table: Sample size and missing data	
S3.5 Table: Model development	
S3.6 Table: Model performance	
S3.7 Table: Results	
S3.8 Table: Discussion	
S4 Table: PROBAST	
S4.1 Table: Risk of Bias (RoB)	
S4.2 Table: Applicability	
S1 Figure: Countries where studies were conducted.	

# Chronic Kidney Disease in Low- and Middle- Income Countries: Protocol for a

### systematic review of diagnostic and prognostic models

Edson J Ascencio<sup>1,2</sup>

Diego J Aparcana-Granda<sup>1,3</sup>

Rodrigo M Carrillo-Larco<sup>3,4</sup>

- 1. Facultad de Medicina Alberto Hurtado, Universidad Peruana Cayetano Heredia, Lima, Perú.
- 2. Emerge, Emerging Diseases and Climate Change Research Unit, School of Public Health and Administration, Universidad Peruana Cayetano Heredia, Lima, Peru
- 3. CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru
- 4. Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK

# Corresponding author

Rodrigo M Carrillo-Larco, MD

Department of Epidemiology and Biostatistics

School of Public Health, Imperial College London, London W2 1PG, UK

E-mail: rcarrill@ic.ac.uk

Phone: +44 0 7578240395

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### **ABSTRACT**

**Background:** Chronic Kidney Disease (CKD) is a highly prevalent condition with a large disease burden globally. In low- and middle-income countries (LMIC) the CKD screening challenges the health system. This systematic and comprehensive search of all CKD diagnostic and prognostic models in LMIC will inform screening strategies in LMIC following a risk-based approach.

**Objective:** To summarize all multivariate diagnostic and prognostic models for CKD in adults in LMIC.

**Methods:** Systematic review. Without date or language restrictions we will search Embase, Medline, Global Health (these three through Ovid), SCOPUS and Web of Science. We seek multivariable diagnostic or prognostic models which included a random sample of the general population. We will screen titles and abstracts; we will then study the selected reports. Both phases will be done by two reviewers independently. Data extraction will be performed by two researchers independently using a pre-specified Excel form (CHARMS model). We will evaluate the risk of bias with the PROBAST tool.

**Conclusion:** This systematic review will provide the most comprehensive list and critical appraisal of diagnostic and prognostic models for CKD available for the general population in LMIC. This evidence could

 inform policies and interventions to improve CKD screening in LMIC following a risk-based approach, maximizing limited resources and reaching populations with limited access to CKD screening tests. This systematic review will also reveal methodological limitations and research needs to improve CKD diagnostic and prognostic models in LMIC.

**Keywords:** Chronic Kidney Disease; Diagnostic Models; Prognostic Models; Low- and Middle-income countries.

### INTRODUCTION

Chronic kidney disease (CKD) is a highly prevalent condition that contributes to a large part of disease burden globally. Between 1990 and 2017, the health metrics of CKD showed a bleak profile: mortality rate, incidence and kidney transplantation rate increased by 2.8%, 29.3% and 34.4%, respectively. CKD led to 1.2 million deaths in 2017 and in the best-case scenario, mortality is projected to increase to 2.2 million deaths and become the 5th cause of years of life lost (YLL) by 2040. Currently, 2.5 million of patients receive kidney transplantation therapy and it is projected to increase to 5.4 million by 2030. CKD also reveals disparities between low- and middle-income countries (LMIC) and high income countries (HIC); for example, the age-standardised disability-adjusted life-year (DALY) rate due to CKD was the highest in LMIC between 1990-2017. In LMIC, that remain as resource-constrained settings, there is a need for optimization of the CKD screening strategies which usually challenge the health system.

Risk equations or risk scores are a cost-effective alternative for CKD screening.<sup>6</sup> These equations are less invasive and accepted by the general population;<sup>7</sup> also, they require less resources like laboratory tests.<sup>8</sup> Many scores were developed in high-income countries,<sup>9-11</sup> and they may not be used in LMIC because their accuracy is better where they have been developed.<sup>12</sup> Current strategies for CKD screening suggest studying people with risk factors (e.g. diabetes, hypertension).<sup>13-15</sup> These recommendations rely on studies where albuminuria and proteinuria were used as screening tools for identifying CKD patients.<sup>16</sup> Nevertheless, a systematic review found that using risk scores allows screening of a larger population and therefore can be useful for detecting more CKD cases.<sup>6</sup>

To date, there are no systematic reviews of diagnostic or prognostic models for CKD with a focus on LMIC. <sup>17, 18</sup> This limits our knowledge of what tools we have to enhance CKD screening in LMIC; similarly, this dearth of evidence prevents from planning future research to overcome the limitations of available models. This will be the first systematic review to fill these knowledge gaps in LMIC to improve and complement the CKD screening programmes in LMIC.

### **METHODS**

### **Objective**

To synthesise CKD diagnostic and prognostic models for the adult population of LMIC.

# Study design

This systematic review and meta-analysis will be conducted following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines. <sup>19</sup> We will also adhere to the recommendations for systematic reviews of diagnostic and prognostic models following the CHARMS guidelines<sup>20</sup> and the PROBAST tool to assess risk of bias. <sup>21</sup>

# Eligibility criteria

*Participants/population:* We will include the general adult population (18 years and above) of LMIC with no gender restrictions. Studies following a population-based random sampling approach will be included. We will only include populations from LMIC according to The World Bank.<sup>22</sup> Conversely, studies with a study population of only patients (e.g., people with hypertension) or high-risk individuals (e.g., smokers) will be excluded. We will exclude studies with LMIC populations outside a LMIC.

Intervention, exposure: None (this review is looking at CKD diagnostic and prognostic models in LMIC).

Outcome: Diagnostic and prognostic models for CKD. The CKD diagnosis should have been based on a laboratory or imaging test including: urine albumin- creatinine ratio, urine protein-creatinine ratio, albumin excretion ratio, urine sediment, kidney images, kidney biopsy or the estimated glomerular filtration rate (eGFR). In other words, research in which CKD diagnosis was based on self-reported information only will not be considered. However, if a study combined both self-reported information and a laboratory or imaging tests, this will be included.

*Types of studies:* Studies with an observational design will be included, which encompasses crosssectional (for diagnostic models) and prospective longitudinal studies (for prognostic models). If we retrieve any systematic review on this subject, we will revise its reference list to identify relevant original sources.

### Literature Search and Data collation

The search will be conducted in five search engines: Embase, Medline, Global Health (these three through Ovid), SCOPUS and Web of Science. No date or language restrictions will be set. The complete search strategy can be found in Supplementary Material.

Titles and abstracts will be screened by two researchers independently (DJA-G and EJA), looking for studies that meet the selection criteria above detailed. Full-text reports of the selected publications will be studied by two researchers independently (DJA-G and EJA). Discrepancies at any stage will be solved by consensus or by a third party (RMC-L).

During the full-text phase, if there are any original reports in which the population, methodology or results are not clear enough to assess the inclusion/exclusion criteria, we will contact the corresponding author by email. We will wait for two weeks, if we receive no answer and cannot solve our doubts through other means, this report will be excluded based on the lack of clarity to assess inclusion/exclusion criteria.

We will record the reasons for exclusion in the full-text phase and summarize the number of included/excluded reports following the PRISMA flow diagram.

### **Data extraction**

 We will develop a data extraction form following the CHARMS recommendations.<sup>20</sup> Data extraction will be conducted by two researchers independently; discrepancies will be solved by consensus or by a third party (RMC-L).

# Risk of bias of individual studies

The risk of bias assessment of individual reports will be conducted using the Prediction model Risk Of

Bias ASsessment Tool (PROBAST) tool.<sup>21</sup>

### **Statistical Analysis**

A qualitative synthesis is planned, whereby we will narratively synthesise the findings from the selected studies. We will summarize the key elements from each report such as study design, study population and characteristics of the study population. Also, we will summarize the key features of the risk scores as provided by each report, including discrimination, calibration, sensitivity, specificity, and predictive values. A quantitative synthesis will be carried out if the included studies are found to be sufficiently homogenous and we have at least four original reports.

### **Ethics**

This review did not directly include human subjects. We considered this work as 'low risk' and did not request approval by an Ethics Committee. Results and opinions included in this protocol, and those included in the final report, are the author's alone and do not represent those of the institutions to which they belong.

 This systematic review will provide a comprehensive list of diagnostic and prognostic models for CKD for people in LMIC, along with their accuracy metrics. Currently, information lacks in LMIC where diagnostic and prognostic models could inform CKD screening strategies. Similarly, this work will elucidate the limitations of available diagnostic and prognostic models for CKD in LMIC, so that future research can be planned accordingly to overcome these caveats and deliver robust models to advance

CKD screening strategies in LMIC.

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# S1 Table: PRISMA Checklist

		BMJ Open  BMJ Open  BMJ Open	36/bmjopen-2021-058921	
S1 Table: PRISI	MA Chec	klist cluding for	021-058921	
Section and Topic	Item #	Checklist item	on 15 March : Era	Location where item is reported
TITLE		<u> </u>	022. Do	
Title	1		ownload ogescho	page 01
ABSTRACT		ta mini	of from	
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	http://bi	page 02
INTRODUCTION	I	lining, a	njopen.	
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	bmj.con	page 03
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	on Ma	page 04
METHODS		ologies	13, 202	
Eligibility criteria	5	•	N	page 04-05
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other source or consulted to identify studies. Specify the date when each source was last searched or consulted to identify studies.	or annsulted.	page 04
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Search strategy	7	I	supplementary page 03-07
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	page 05
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers content they worked independently, any processes for obtaining or continuing data from study investigators, and if applicable, details of automation tools used in the processes in the processes.	page 05-06
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results the recompatible with each outcome domain in each study were sought (e.g. for all measures, the points, analyses), and if not, the methods used to decide which results to collect.	page 04-05, table 1
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	page 04-05, table 1
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently and if applicable, details of automation tools used in the process.	page 06
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used to synthesis or presentation of results.	NA
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	page 06
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as andling of missing summary statistics, or data conversions.	NA
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	page 06

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	13d	<u>o</u> <u>I</u>	page 06
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	NA
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized and because of the synthesized and synthesized and because of the synthesized and because of the synthesized and synthesized and synthesized and synthesized and syn	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthes sing from reporting biases).	NA
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	page 11
RESULTS		p://bmj	
Study selection	16a	Describe the results of the search and selection process, from the number of records defined in the search to the number of studies included in the review, ideally using a flow diagram.	page 06-07
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded why they were excluded.	page 06-07
Study characteristics	17	Cite each included study and present its characteristics.  Chnologies  2025	page 08-09
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	page 11, supplementary page 39-45

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Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally structured tables or plots.	page 9-11
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among control studies.	page 9-11
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of attainments attained between the direction of the effect.	table 3
	20c	Present results of all investigations of possible causes of heterogeneity among study হিছু প্রত	NA
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the sent results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each out on assessed.	page 11
DISCUSSION		hilar teo	
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	page 11
	23b	Discuss any limitations of the evidence included in the review.	page 11-13
	23c	Discuss any limitations of the review processes used.	page 11-13
		e e	I

		BMJ Open  BMJ Open  BMJ Open  BMJ open-2021-058921  Discuss implications of the results for practice, policy, and future research.	
	23d	Discuss implications of the results for practice, policy, and future research.	page 14-15
OTHER INFORMA	ATION	on 15 N	
Registration and protocol	24a	state that the review was not registered.	page 04
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not be accessed.	page 04
	24c	Describe and explain any amendments to information provided at registration or in the Boccol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	page 01
Competing interests	26	Declare any competing interests of review authors.	page 01
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	page 15
NA: Not applicable		n May 13, 202 echnologies.	
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# S2.1 Table: Embase, Medline and Global Health (OVID)

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### S2.2 Table: SCOPUS

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#### S2.3 Table: WEB OF SCIENCE

(((chronic renal insufficiency) OR (chronic kidney disease) OR (chronic kidney failure) OR (CKD) OR (Renal Insufficiency, Chronic) OR (chronic NEAR/2 kidney NEAR/2 disease) OR (chronic NEAR/2 kidney NEAR/2 failure) OR (chronic renal failure) OR (chronic renal disease) OR (chronic kidney insufficiency) OR (end stage renal disease) OR (ESRD) OR (kidney function) OR (renal function) OR (kidney dysfunction) OR (renal dysfunction)) AND (("Afghanistan") OR ("Benin") OR ("Burkina Faso") OR ("Burundi") OR ("Central African Republic") OR ("Chad") OR ("Comoros") OR ("Democratic Republic of the Congo") OR ("Eritrea") OR ("Ethiopia") OR ("Gambia") OR ("Guinea") OR ("Guinea-Bissau") OR ("Haiti") OR ("Democratic People's Republic of Korea") OR ("Liberia") OR ("Madagascar") OR ("Malawi") OR ("Mali") OR ("Mozambique") OR ("Nepal") OR ("Niger") OR ("Rwanda") OR ("Senegal") OR ("Sierra Leone") OR ("Somalia") OR ("South Sudan") OR ("Tanzania") OR ("Togo") OR ("Uganda") OR ("Zimbabwe") OR ("Armenia") OR ("Bangladesh") OR ("Bhutan") OR ("Bolivia") OR ("Cape Verde") OR ("Cambodia") OR ("Cameroon") OR ("Congo") OR ("Cote d'Ivoire") OR ("Djibouti") OR ("Egypt") OR ("El Salvador") OR ("Ghana") OR ("Guatemala") OR ("Honduras") OR ("India") OR ("Indonesia") OR ("Kenya") OR ("Micronesia") OR ("Kosovo") OR ("Kyrgyzstan") ÓR ("Laos") ÓR ("Lesotho") OR ("Mauritania") OR ("Moldova") ÓR ("Mongolia") OR ("Morocco") OR ("Myanmar") OR ("Nicaragua") OR ("Nigeria") OR ("Pakistan") OR ("Papua New Guinea") OR ("Philippines") OR ("Samoa") OR ("Atlantic Islands") OR ("Melanesia") OR ("Sri Lanka") OR ("Sudan") OR ("Swaziland") OR ("Syria") OR ("Tajikistan") OR ("Timor-Leste") OR ("Tonga") OR ("Tunisia") OR ("Ukraine") OR ("Uzbekistan") OR ("Vanuatu") OR ("Vietnam") OR ("Middle East") OR "Yemen") OR ("Zambia") OR ("Albania") OR ("Algeria") OR ("American Samoa") OR ("Angola") OR ("Argentina") OR ("Azerbaijan") OR ("Republic of Belarus") OR ("Belize") OR ("Bosnia and Herzegovina") OR ("Botswana") OR ("Brazil") OR ("Bulgaria") OR ("China") OR ("Colombia") OR ("Costa Rica") OR ("Cuba") OR ("Dominica") OR ("Dominican Republic") OR ("Equatorial Guinea") OR ("Ecuador") OR ("Fiji") OR ("Gabon") OR ("Georgia") OR ("Grenada") OR ("Guyana") OR ("Iran") OR ("Iraq") OR ("Jamaica") OR ("Jordan") OR ("Kazakhstan") OR ("Lebanon") OR ("Libya") OR ("Macedonia (Republic) ") OR ("Malaysia") OR ("Indian Ocean Islands") OR ("Mexico") OR ("Montenegro") OR ("Namibia") OR ("Palau") OR ("Panama") OR ("Paraguay") OR ("Peru") OR ("Russia") OR ("Serbia") OR ("South Africa") OR ("Saint Lucia") OR ("Saint Vincent and the Grenadines") OR ("Suriname") OR ("Thailand") OR ("Turkey") OR ("Turkmenistan") OR ("Venezuela") OR (developing countr) OR (lowincome countr\*) OR (middle-income countr\*) OR (lowmiddle income countr\*) OR (upper-middle income countr\*)) AND ((risk assessment) OR (risk equation\$) OR (risk chart?) OR (risk NEAR/3 tool\$) OR (risk assessment function?) OR (risk assessor) OR (risk appraisal\$) OR (risk calculation\$) OR (risk calculator\$) OR (risk factor\$ calculation\$) OR (risk engine\$) OR (risk equation\$) OR (risk table\$) OR (risk threshold\$) OR (risk disc?) OR (risk disk?) OR (risk scoring method?) OR (scoring scheme?) OR (risk scoring system?) OR (risk scal\$) OR (risk prediction?) OR (risk algorith\$) OR (prediction model\$) OR (predictive instrument?) OR (project\$ risk?) OR (predictive model?) OR (scoring method\$) OR (prediction\$ NEAR/3 method\$) OR (risk? NEAR/1 assess\$) OR (screening) OR (diagnostic test))) NOT ((animal\*) OR ("not humans"))

			action form				BMJ Open	by copyright, including for	36/bmiopen-2021-058921 on 15			Pa
	os.i Table	Sour ce of data	of data and	a partici	pants		Pa	es related to t	15 Warch 2022. D			
N°	Study	Sour ce of data	Partici pant locati on	Ba sel in e ye ar	En d ye ar (c oh ort s)	Sam pling	Inclusion criteria	ext and data mining,	Out come prevalence (%)	Outc ome incid ence (for coho rts)	Baseli ne mean age	Baselin e % men
1	Asgari, 2020 Europea n Risk Assess ment tool (6- years validatio n)	Cohort	Communit y	1999- 2005	2011	Random	Tehran lipids and glucose study (TLGS) cohort participants.	Persons with prevaled Cardiovascular Disease (CVD), Type 2 Diabet Mellitus or End-stage Renal	597 Department 46.02	40.1%	58.34	29.53

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									smoking status as well s participants with missing data during follow-up or Cr, FPG, 2 h-PCG and C				
		Asgari, 2020 Europea n Risk Assess ment tool (9- years validatio		Communit	1999-	2009-	<i>D</i> 6	Tehran lipids and glucose study (TLGS) cohort	Persons with prevalent of Cardiovascular Disease (CVD), Type 2 Diabetes of CVD), Type 2 Diabetes of CVD, Type 2 Diabetes of	Downloaded from biter/flowiogen bmi			
	1	n)	Cohort	У	2005	2018	Random	participants. Any individual aged ≥20	ctatue 7 (	NI	40.6%	48.20	49.70
		Bradsha w, 2019 - Model 1 (derivati		Communit		ļ		years and permanently residingin at Delhi and Chennai (CARRS-II). A permanent resident was defined as a person living in the selected household, was related to the household head and ate at least 3 meals in a week	pregnant women, participants with missing both or either serum creatinine or urine albumin- to- creatinine ratio data and	44.9			
L	2	on)	sectional	У	2015	n/a	Random	with the family.		(13.5)	46.8%	48.20	49.70

Any individual aged ≥20 years and permanently residingin at Delhi and Chennai (CARRS-II). A permanent resident was defined as a person living in the selected household, was related to the household head and ate at least 3 meals in a week with the family. Households were defined	Any individual aged ≥20 years and permanently residingin at Delhi and Chennai (CARRS-II). A permanent resident was
Chennai (CARRS-II). A permanent resident was	Any individual aged ≥20 years and permanently residingin at Delhi and Chennai (CARRS-II). A permanent resident was
Chennai (CARRS-II). A នូក្ខិន្និ	Any individual aged ≥20 years and permanently residingin at Delhi and Chennai (CARRS-II). A
Any individual aged ≥20   \$\frac{\pi}{2} \frac{\pi}{2} \f	are constructed visitors

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								5	7			
	3a						(CARRS-I). A permanent	both or either serum <mark>은</mark>	<u> </u>			
	(CARRS						resident was defined as a	creatinine or urine albur <del></del> in-§	ģ l			
	-l urban						person living in the	to- creatinine ratio data and	2			
	validatio						selected household, was	participants on dialysi <b>g</b> .	<b>2</b>			
	n)						related to the household		<u>.</u>			
	,						head and ate at least 3	ses	7			
							meals in a week with the	i re	<b>5</b>			
							family. Households were	r uses related to te	<u> </u>			
							defined as "a group of	asr	20			
							people wholive together,	to	3			
							usually pool their income	te:	b			
							and eat atleast one meal	xt a	₽			
						1	together a day when they	anc and	-			
							are at home. This does	i di	<u> </u>			
							not include people who	ata	<u> </u>			
							have	⋾: ३	•			
							migratedpermanently or	in <u>i</u> ì	<b>§</b>			
							are considered visitors"	mining,				
							10	Participants with missing				
								both or either serumជី	lb <sub>u</sub>			
							UDAY cohort participants	creatinine or urine alburain-	<u>.</u>			
	Bradsha						((a) adults aged ≥30 years	to- creatinine ratio data,				
	w, 2019						residing in the sampled	unwilling to provide ๊ฐ	<u>.</u>			
	- Model						urban and rural areas of	informed consent, with				
	3a						Sonipat and Vizag,	serious chronic illness				
	(UDAY						respectively; and (b)	such as that of the liver				
	rural						willing to participate and	(cirrhosis), kidneys (renal s				
	validatio	Cross-	Communit				provide informed	railure) or malignancieຊື່ງ,	<b>É</b>			
2	n)	sectional	у	2014	n/a	Random	consent).	and pregnant women	NI	NI	47.20	38.00
	•		,				·	Being pregnant, having	)			
	Carrillo-								<u> </u>			
	Larco,							tuberculosis, and having	2025			
	2017 -							any disability preventing	<u> </u>			
	CRONI							from undergoing				
	CAS-						Full time resident, capable	anthropometric				
	CKD						of giving informed	assessments, having CKD,	<u> </u>			
	(derivati	Cross-	Communit	2013-			consent, one subject per	missing values in the	57.7			
3	on	sectional	у	2014	n/a	Random	household.	prediction variables, missing	(12.4)	49.4%		
									л П			

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	complet e)							values in key variables controlled to calculate eGFR, subjects with BMI >40 kg/m2 or 60 kg/m2.	1-0589		
3	Carrillo- Larco, 2017 - CRONI CAS- CKD (derivati on lab- free)	Cross- sectional	Communit y	2013- 2014	n/a	Random	Full time resident, capable of giving informed consent, one subject per household.	Being pregnant, havirs active pulmonary stuberculosis, and having any disability preventing from undergoing anthropometric assessments, having Crassing values in the prediction variables, missing values in key variables calculate eGFR, subjects with BMI >40 kg/m2 or EMI <18.5 kg/m2.	aded :	49.4%	
3	Carrillo- Larco, 2017 - CRONI CAS- CKD (validati on complet e)	Cross-sectional	Communit	2004- 2006	n/a	Random	PREVENCION cohort participants.	Report having CKD, missing values in key variables to calculate eGFR, subjects with BMI >40 kg/m2 or MMI <18.5 kg/m2, age < 35 years, missing values to the calculate with the calculate in the calculate with the calculate and the calculate with the calculate wi	<del>nen b</del>	47.7%	
3	Carrillo- Larco, 2017 - CRONI CAS- CKD (validati on lab- free)	Cross- sectional	Communit	2004- 2006	n/a	Random	PREVENCION cohort participants.	Report having CKD, misging values in key variables concalculate eGFR, subjects with BMI >40 kg/m2 or BMI <18.5 kg/m2, age < 35 years, missing values in prediction variables.	57.1 (12.6)	47.7%	
4	Mogueo , 2015 -	Cross- sectional	Communit y	2008- 2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missing data on all variables, except	55 (15)	23.4%	

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	Korean model (eGFR validatio n)							anaemia anaemia for us	2021 DE0021 OF 4		
4	Mogueo , 2015 - Thai model (eGFR validatio n)	Cross- sectional	Communit y	2008- 2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missings data on all variables, execution kidney stones	55 (15)	23.4%	
4	Mogueo , 2015 - Korean model (eGFR or proteinu ria validatio n)	Cross- sectional	Communit	2008- 2011	n/a	Random	Cape Town Bellville-South study cohort participants.	Participants with missing data on all variables, except	looded from bitos/llow	23.4%	
4	Mogueo , 2015 - Thai model (eGFR or proteinu ria validatio n)	Cross- sectional	Communit	2008-2011	n/a	Random		and similar	lani apar/on Mo. 43	23.4%	
5	Saranbu rut, 2017 - Framing ham Heart	Cohort	Communit y	2002	2012	Random	Employees of the Electric Generating Authority of Thailand (EGAT) who participated in a health survey in 2002	Subjects who had CKD at baseline or did not have serum creatinine at baseline or at follow-up.	ot Dopporte	70.8%	

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	Saranbu						EGAT 1-2 cohort	<u> </u>	<b>5</b>		
	rut,						participants with	including	021_05802		
	2017 -						preserved GFR (estimate	ng	<u>Ş</u>		
	Model 2						glomerular filtration rate	Patients who died, retired,	<u> </u>		
	(derivati						(eGFR) ≥ 60		ĥ		
	` on						mL/min/1.73m2) at	participate o had witl	7 2		
	Clinical						baseline who attended	missing baseline seruan_	<b>-</b>		
	+						both the examinations	creatinine data. Also	<del>}</del>		
	Limited						(EGAT 1 5rd examination	patients with eGFR<60 4	<u> </u>		
	laborato		Communit	2002-	2012-		` and EGAT 2 4nd	patients with eGFR<60 baseline in 2002-2003 week	51.3		
6	ry tests)	Cohort	V	2003	2013	Random	examination).	excluded $\mathfrak{S}$	(7.4)	70.5%	
	,						EGAT 1-2 cohort	<del>ို</del> တွဲ			
	Saranbu						participants with	ind sign	<u>}</u>		
	rut,					( ) _	preserved GFR (estimate	da	<u>}</u>		
	2017 -						glomerular filtration rate	Patients who died, retired,	<u> </u>		
	Model 3						(eGFR) ≥ 60	moved, did not want 🗟 🕺	5		
	(derivati						mL/min/1.73m2) at	participate o had with	3		
	` on						baseline who attended	missing baseline seru			
	Clinical						both the examinations	creatinine data. Also <b>≱</b>			
	+ Full						(EGAT 1 5rd examination	patients with eGFR<60aat			
	laborato		Communit	2002-	2012-		and EGAT 2 4nd	baseline in 2002-2003 være	51.3		
6	ry tests)	Cohort	У	2003	2013	Random	examination).	excluded 💆	(7.4)	70.5%	
	Saranbu						EGAT 3 cohort	Participants younger then			
	rut,						participants with	40 years old at baseline,	<u>.</u>		
	2017 -						preserved GFR (eGFR ≥	with missing serum 🛱	3		
	Model 1						60) at baseline in 2009	creatinine values, parrients	<b>L</b>		
	(validati						(EGAT 3 1st examination)	who died, retired and	<b>2</b>		
	on						who were followed up 5	moved, unwilling to 🛱	\$		
	Clinical		Communit				years later in 2014 (EGAT	participate and with a	45.6		
6	only)	Cohort	У	2009	2014	Random	3 2nd examination).	eGFR <60 at baseling	(4.2) د	75.5%	
	Saranbu						EGAT 3 cohort	Participants younger than 40 years old at baseline,	<b>b</b>		
	rut,						participants with	40 years old at baseline,	F		
	2017 -						preserved GFR (eGFR ≥	with missing serum	<b>.</b>		
	Model 2						60) at baseline in 2009	creatinine values, parrients	7		
	(validati						(EGAT 3 1st examination)	who died, retired and	<b>E</b>		
	on						who were followed up 5	moved, unwilling to	Ē		
	Clinical		Communit			_	years later in 2014 (EGAT	participate and with an	45.6		
6	+	Cohort	У	2009	2014	Random	3 2nd examination).	eGFR <60 at baseline.	(4.2)	75.5%	
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	Limited laborato ry tests)							ncluding	1 <del>-058921</del>		
7	Thakkin stian, 2011 (derivati on)	Cross- sectional	Communit V	2007- 2008	n/a	Random	Global Screening and Early Evaluation of Kidney Disease (SEEK) study subjects: being 18 years or older, had no menstruation period for at least a week prior to the examination date if women, and whom were willing participants of the study and provided signed consent forms.	Frasmushogeschool for uses related to text and data and d	<del>on 15 March 2022. Downloaded</del> 45.79)	45.5%	
8	Wen, 2020 - Simple Risk Score (derivati on)	Cohort	Communit V	2006-2007	2012- 2013	Random	Handan Eye Study (HES) participants (rural residents aged ≥30 years old living in Yongnian County).	Subjects who were diagnosed with CKD unwilling to participate missing follow up data (eGFR or UACR).	**************************************	44.7%	
8	Wen, 2020 - Best-fit Risk Score (derivati on)	Cohort	Communit	2006- 2007	2012- 2013	Random	Handan Eye Study (HES) participants (rural residents aged ≥30 years old living in Yongnian County).	Subjects who were midiagnosed with CKD are unwilling to participate missing follow up data (eGFR or UACR).	50 (10)	44.7%	
9	Wu, 2016 (derivati on)	Cross- sectional	Communit y	2012	n/a	Random	Adults older than 18 years and having given consent to this study.	Participants without: age information; body mass index (BMI) information; blood pressure (BP) measurement; serum creatinine test.	13. 2025 at Depart (14.3)	56.7%	
9	Wu, 2016	Cross- sectional	Communit y	2012	n/a	Random	Adults older than 18 years and having given consent to this study.	Participants without: age information; body mass index (BMI) information;	## 41.8 6 (11.7) EE	63.7%	

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					pen-202 yright, ir		
alidati on)				blood pressure (B measurement; serv creatinine test.	1 <del>-058921</del> ncluding		
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S3.2	Table::	Outcome
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			Outcome	g for uses rea			
N°	Study	Outcome	Outcome details	Same Same outcome testing definition feating all patients and	u	Predictor s part of the outcome	Mean follow- up (years) (cohorts
1	Asgari, 2020 European Risk Assessment tool (6-years validation)	CKD composite	CKD was defined as eGFR < 60 mL/min/1.73 m2, provided by the Modification of Diet in Renal Disease (MDRD).	data mining, Yes	NI	No	6.2
1	Asgari, 2020 European Risk Assessment tool (9-years validation)	CKD composite	CKD was defined as eGFR < 60 mL/min/1.73 m2, provided by the Modification of Diet in Renal Disease (MDRD).	Al training, and	NI	No	9.2
2	Bradshaw, 2019 - Model 1 (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes amilar	. NI	No	0
2	Bradshaw, 2019 - Model 2 (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes Yes	NI	No	0
2	Bradshaw, 2019 - Model 3a (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	ogies. Yes	NI	No	0
2	Bradshaw, 2019 - Model 3b (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes	NI	No	0
2	Bradshaw, 2019 - Model 3a	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 (estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes	NI	No	0

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				ight, in	5 5 5 7 7		
	(CARRS-I urban			clud	7072		
	validation) Bradshaw, 2019			e iii g	<u>§</u>		
	- Model 3a			fo	_		
	(UDAY rural	CKD	CKD was defined as an eGFR rate <60 mL/min/1.73 m2	su.	7 7		
2	validation)	composite	(estimated by the CKD-EPI equation) or UACR ≥30 mg/g	Yes 🕏	5 NI	No	0
	Carrillo-Larco, 2017 - CRONICAS- CKD (derivation	CKD	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also	Frasmushog Frelated to text Yes	arch 2022		
3	complete)	composite	known as CKD stage III	Yes <b>te</b>	Yes	No	0
	Carrillo-Larco, 2017 - CRONICAS- CKD (derivation	CKD	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also	jeschool and data	_ <del>1</del>		
3	lab-free)	composite	known as CKD stage III	Yes 💆	Yes	No	0
3	Carrillo-Larco, 2017 - CRONICAS- CKD (validation complete)	CKD composite	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also known as CKD stage III	ing, Al training, Yes	Yes	No	0
	Carrillo-Larco,	composite	Known as one stage in	100 0	100	140	
3	2017 - CRONICAS- CKD (validation lab-free)	CKD composite	CKD defined as an eGFR <60 mL/min/1.73m2, using the MDRD (Modification of Diet in Renal Disease) formula, also known as CKD stage III	and similar Yes	Yes	No	0
4	Mogueo, 2015 - Korean model (eGFR validation)	CKD composite	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula		NI	No	0
	Mogueo, 2015 - Thai model (eGFR	CKD	eGFR <60 ml/min/1.73 m2 based on the 4-variable	·	) ) ) )		
4	validation)	composite	Modification of Diet in Renal Disease (MDRD) formula	Yes	NI NI	No	0
	Mogueo, 2015 - Korean model	CKD	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula and 'any nephropathy' including any of the stages I to V of the		NI		
4	(eGFR or	composite	Kidney Disease: Improving Global Outcomes Chronic	Yes	NI NI	No	0

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	proteinuria validation)		Kidney Disease (KDIGO) classification	t, includi	2021 <u>-0589</u>		
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	CKD composite	eGFR <60 ml/min/1.73 m2 based on the 4-variable Modification of Diet in Renal Disease (MDRD) formula and 'any nephropathy' including any of the stages I to V of the Kidney Disease: Improving Global Outcomes Chronic Kidney Disease (KDIGO) classification	ng for uses re Yes	\(\frac{1}{21}\) on 15 Marq	No	0
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	CKD composite	CKD was defined as estimate glomerular filtration rate (eGFR) <60 mL/min/1.73 m2 using the Modification of Diet in Renal Disease (MDRD)	ated to text and series of the	22. Downl	No	10
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	CKD composite	CKD defined as (eGFR) <60 mL/min/1.73 m2 using the CKD-EPI equation.	data mining, Ali	Z	No	10
6	Saranburut, 2017 - Model 1 (derivation Clinical only)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	raining, and similar	bmjopen.bmj.com/	No	10
6	Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	r technologies. Yes	≥ on May 13, 2025 at	No	10
	Saranburut, 2017 - Model 2 (derivation Clinical + Limited	CKD	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology		Department		
6	laboratory tests)	composite	Collaboration (CKDEPI) equation using the non-black	Yes	<u>r</u> E	No	10

			BMJ Open	d by copyrig	36/bmjopen-2021 <u>-0589</u> 21		
				ht, inc	1-2021		
			coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	Slud	-058		
6	Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	by copyright, including for uses related s	Z on 15 March 20 Erasr	No	10
6	Saranburut, 2017 - Model 1 (validation Clinical only)	CKD composite	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO definition of CKD stage 3-5	to text and data min	2. Downloaded	No	5
6	Saranburut, 2017 - Model 2 (validation Clinical + Limited	CKD	Preserved GFR (eGFR ≥60) at baseline and subsequently developed decreased GFR (eGFR < 60 mL/min/1.73m2) at the 10 year follow-up calculated according to two-level race variable Chronic Kidney Disease–Epidemiology Collaboration (CKDEPI) equation using the non-black coefficient. The outcome is a modification from the KDIGO	Yes	m http://bmjopen.	No	
7	Iaboratory tests)  Thakkinstian, 2011 (derivation)	CKD composite	definition of CKD stage 3-5  CKD was defined as stage I & II if GFR ≥ 90 and GFR 60-89 ml/min/1.73 m2 with haematuria and/or albumin-creatinine ratio 30 mg/g or greater, stage III, IV, and V if the GFR of 30-59, 15-29, and < 15 ml/min/1.73 m2 respectively, regardless of kidney damage. eGFR was calculated using the MDRD equation for IDMS traceable serum creatinine values.	Yes Yes Yes	Nay 13,	No No	0
8	Wen, 2020 - Simple Risk Score (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 ((assessed by the modified Chinese MDRD equation) or UACR ≥30 mg/g	Yes	2025 at De	No	5.6
8	Wen, 2020 - Best-fit Risk Score (derivation)	CKD composite	CKD was defined as an eGFR rate <60 mL/min/1.73 m2 ((assessed by the modified Chinese MDRD equation) or UACR ≥30 mg/g	Yes	Partment GE	No	5.6

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Wu, 2016   CKD   Reduced eGFR was defined as eGFR-60 mL/min/1.73 m2   Yes   GR   SR   NI   No   0						; X			
9 (derivation) composite using the CKD-EPI equation. 9 (validation) composite using the CKD-EPI equation. 10 (validation) composite using the CKD-EPI equation. 11 (composite using the CKD-EPI equation) composite using the CKD-EPI equation. 12 (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) composite using the CKD-EPI equation (composite using the CKD-EPI equation) (composite using the CK		Wu, 2016	CKD	Reduced eGFR was defined as eGFR<60 mL/min/1.73 m2		i k			
Wu, 2016 CKD Reduced eGFR was defined as eGFR-60 mL/min/1.73 m2 Ye S S NI No 0  CKD, chronic kidney disease; CKD-EPI, chronic kidney disease epidemiology collaboration; eGFR, estimated glomerular filtration rate; GFR, ggmetytar filtration rate; KDIGO, MDRD, modification of diet renal disease; n/a, not applicable; NI, no information; UACR, urinary albumin-to-creatinine ratio.  Beginning and similar recommon or similar recommendation.	9	(derivation)	composite	using the CKD-EPI equation.	Yes	3 89	NI	No	0
9 (validation) composite using the CKD-EPI equation. Yes 9, B NI No 0 CKD, chronic kidney disease; CKD-EPI, chronic kidney disease; Extended glomerular filtration rate; GFR, gligheregate filtration rate; KDIGO, MDRD, modification diet renal disease; n/a, not applicable; NI, no information; UACR, urinary albumin-to-creatinine ratio.  8		Wu, 2016	CKD	Reduced eGFR was defined as eGFR<60 mL/min/1.73 m2	<u> </u>	21			
CKD, chronic kidney disease; CKD-EPI, chronic kidney disease epidemiology collaboration; cGPR, estimated glomerular filtration rate; CFR, eggest March 2022. Downloaded from http://bm/jopen.bm/com/ on May 13, 2025 at Department GEZ.  Frangushogeschool.  All training, and similar technologies.	9	(validation)	composite	using the CKD-EPI equation.	Yes S	3 8	NI	No	0
For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml	of diet	renal disease; n/a, not	applicable; NI, no in	For peer review only - http://bmjopen.bmj.com/site/about/g	uidelines.xhtml	March 2022. Downloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA Erasmushogeschool es related to text and data mining. Al training, and similar technologies			30

# S3.3 Table: Candidate predictors

					В	MJ Open	by copyri	:6/bm jope	P
S	3.3 Table: 0	Candidate	e predicto	rs			d by copyright, including for	36/bmjopen-2021-058921	
						Candidate Predictors	for	on and a second	
N°	Study	Nu mb er of can did ate pre dict ors	Num ber of predi ctors in the final mod el	Predi ctors timing	List of predictors in the final model		Erasmushogeschool uses related to text and data	March 2022 Predictors ascertainment	Predictors modelling
1	Asgari, 2020 European Risk Assessme nt tool (6- years validation)	n/a	18	NI	Age; BMI (body mass index); waist circumference; use of antihypertensives; current smoking, parent and/or sibling with myocardial infarction or stroke; parent and/or sibling with diabetes.  Age; BMI (body mass index); waist	respectively) Age (<45, ≥45 to <50, ≥50 to <55, ≥55 to <60, ≥60 to <65, ≥65 to <70, ≥70 to	mining, Al training, and similar technologi	from http://bmjopen.bmj.cgm	n/a
1	2020 European Risk Assessme nt tool (9- years validation)	n/a	18	NI	circumference; use of antihypertensives; current smoking, parent and/or sibling with myocardial infarction or stroke; parent and/or sibling with diabetes.	<75, ≥75 to <85); Body mass index (<25, ≥25 to <30, ≥30); Waist circumference [<94, ≥94 to <102, ≥102 (for men) and <80, ≥80 to <88, ≥88 (for women)]; use of antihypertensive medications; current smoking ('who smokes cigarettes daily	BI (	ສຸ was calculated as weight g) divided by height (m2). Data collected by trained erviewer using a standard questionnaire	n/a

Bradshaw, 2019 - Model 3a (derivation 2 ) NI				~		<u></u>		distribution, categorical variables were summarized using percentages and counts.  All continuous variables used cubic spline terms
hologies.	2019 - Model 3a	NI	NI		NI	ded from http://bmjopen.bmj.com/ on N	NI	with knots placed at fixed quantiles of the predictor's marginal distribution, categorical variables were summarized using percentages and counts.
Bradshaw, 2019 - Model 3b (derivation 2 ) 8 NI NI NI NI NI NI NI NI	2019 - Model 3b							All continuous variables used cubic spline terms with knots placed at fixed quantiles of

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					В	MJ Open	36/bmjopen	Pi
	CRONICA S-CKD (derivation lab-free)					hypertension and currently under treatment).	by copyright, including for uses related to the resonance on the diagnosis and the d	
3	Carrillo- Larco, 2017 - CRONICA S-CKD (validation complete)	n/a	7	NI	Age; hypertension; anemia.	Age (< 50, 50-69, ≥ 70 years), hypertension (blood pressure ≥ 140/9 mmHg OR previous diagnosis of hypertension and currently under treatment) and anemia (haemoglobin < 13 g/dL if male and < 12 g/dL if female).	Age (information was collected by trained collected by trained interviews), hypertension (blood pressure conducted according to the recommendations of the 7th Joint National Committee on the diagnosis and	n/a
3	Carrillo- Larco, 2017 - CRONICA S-CKD (validation lab-free)	n/a	5	NI	Age; hypertension.	00	Age (information was collected by trained fiedworkers through face-to-face interviews), hypertension (blood pressure measurements were conducted according to the recommendations of the 7th Johnt National Committee on	n/a
4	Mogueo, 2015 -	n/a	8	NI	Age; sex; diabetes mellitus; hypertension; use	Age (50-59, 60-69, ≥70); Female gender; Hypertension (history of	Participants received a standardized interview (Age	NI

f 94					В	illness, taking antihyper-tensive drug(s) or had systolic blood pressure	36/bmjopen-202	
	Korean model (eGFR validation)			~	of statins; proteinuria	2 140 mining of diastolicblood pressure	ogand sex) and physical examination during which blood pressure was measured according to the World Health Organisation (WHO) suidelines using a semi-automated digital blood pressure monitor (Rossmax USA) on the right arm in the sitting position. Sticipants with no history of exector diagnosed diabetes distributed by the sitting position of the sitting position.	
4	Mogueo, 2015 - Thai model (eGFR validation)	n/a	8	NI	Age; diabetes mellitus; hypertension	Age (<40, 40-59, 60-69, >70); Hypertension (history of illness, taking antihyper-tensive drug(s) or had systolic blood pressure ≥140 mmHg of diastolicblood pressure ≥90 mmHg); Diabetes (history of illness, taking oral hypoglycaemicagents or fasting plasma glucose levels≥126 mg/dL)	the WHO  Participants received a standardized interview (Age) and physical examination dering which blood pressure was measured according to the World Health Organisation WHO) guidelines using a semi-automated digital blood pressure monitor (Rossmax Pa, USA) on the right arm in g the sitting position. Participants with no history of elector diagnosed diabetes meditus underwent a 75 g oral	NI
7	Mogueo, 2015 - Korean model	11,0	<u> </u>	141	Age; sex; diabetes mellitus; hypertension; use	Age (50-59, 60-69, ≥70); Female gender; Hypertension (history of illness, taking antihyper-tensive drug(s) or had systolic blood pressure	Participants received a standardized interview (Age and sex) and physical	141
4	(eGFR or	n/a	8	NI	of statins; proteinuria	≥140 mmHg or diastolicblood pressure		NI

					В	MJ Open	36/bmjopen-202 <sup>,</sup>	Р
	proteinuria validation)					≥90 mmHg); Diabetes (history of illness, taking oral hypoglycaemicagents or fasting plasma glucose levels≥126 mg/dL);	according to the World Health Conganisation (WHO) Conganisation (W	
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	n/a	8	NI	Age; diabetes mellitus; hypertension	Age (<40, 40-59, 60-69, >70); Hypertension (history of illness, taking antihyper-tensive drug(s) or had systolic blood pressure ≥140 mmHg of diastolicblood pressure ≥90 mmHg); Diabetes (history of illness, taking oral hypoglycaemicagents or fasting	Participants received a standardized interview (Age) and physical examination dering which blood pressure was measured according to the World Health Organisation (WHO) guidelines using a stani-automated digital blood pressure monitor (Rossmax Po, USA) on the right arm in the sitting position.  Paticipants with no history of dector diagnosed diabetes malitus underwent a 75 g oral	NI
5	Saranburu t, 2017 - Framingh am Heart Study (MDRD validation)	n/a	5	NI	Diabetes mellitus; hypertension; eGFR category	Diabetes mellitus (yes); hypertension (yes); eGFR category (60-74, 75-89, 90-119)	Hypertension was defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or use gof oral antihypertensive medication. Diabetes mellitus gircose of ≥126 mg/dl or use	n/a

4					BI	MJ Open	36/bmjopen-202	
							g medications. eGFR was estimated using the Midification of Diet in Renal sease (MDRD) equation.	
5	Saranburu t, 2017 - Framingh am Heart Study (CKD-EPI validation)	n/a	16	NI	Age; diabetes mellitus; hypertension; eGFR category	Age (30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-85); diabetes mellitus (yes); hypertension (yes); eGFR category (60-74, 75-89, 90-119)	1. the chronic kidney disease—	n/a
	Saranburu t, 2017 - Model 1 (derivation Clinical	1.5	45	NI	Age; sex; systolic blood pressure; waist circumference; diabetes	(male, female); Waist circumference (≤80 for male or ≤90 for male, >80 for female or >90 for male); Diabetes (yes, no); Systolic blood pressure (<120, 120-129, 130-139, 140-149,	diabetes. Waist circumference ជាwas measured midway between the lowest ribs and	NII
6	only) Saranburu t, 2017 - Model 1 BMI	15	15	NI	mellitus  Age; sex; systolic blood pressure; body mass index	150-159, ≥160)  Age (<45, 45-54, 55-59, ≥55); Sex (male, female); BMI (<25, ≥25); Diabetes (yes, no); Systolic blood pressure (<120, 120-129, 130-139,	the iliac crest.  Age (health survey), sex (health survey). Hypertension was defined as systolic blood pressure ≥ 140 mmHg or digstolic blood pressure ≥ 90	NI
6	(derivation	15	15	NI	(BMI); diabetes mellitus	140-149, 150-159, ≥160)	mmHg or use of oral	NI

	Clininal			1		ı .	autikum autamaiya maadiaatian	
	Clinical						arthinypertensive medication.	
	only)						Dispetes mellitus was defined	
						<u> </u>	a <b>S</b> a fasting glucose of ≥126	
						9	m <b>g</b> /dl or a positive history of	
							djabetes. Body mass index	
						9	≝as defined as weight in	
						ā		
							ត្ត ទីquare of height in meters	
						Š	ge (health survey), sex	
						[	சூealth survey). Hypertension	
						<u> </u>	ਡੱਫ਼ defined as systolic blood	
							ິ⇔ ≸ressure ≥ 140 mmHg or	
					<b>/</b>		aliestolic blood pressure ≥ 90	
							ក្នុំ mmHg or use of oral antihypertensive medication.	
							Diabetes mellitus was defined	
							as a fasting glucose of ≥126	
					Deer/	ق	mg/dl or a positive history of	
						y, Ar nailing, and	dabetes. Serum creatinine	
					•	$\mathbb{C}_{1}$	(SCr) was measured by the	
						2	engymatic assay on the Vitros	
							350 analyzer (Ortho-Clinical	
						9	Diagnostics, USA) using	
							MS-Standard Reference	
	Saranburu							
							Material (SRM) 967 as the	
	t, 2017 -						standard. Estimate glomerular	
	Model 2					A / 45 45 54 55 50 > 55 O	gltration rate (eGFR) was	
	(derivation				A	Age (<45, 45-54, 55-59, ≥55); Sex	T - =	
	Clinical +				Age; sex; systolic blood	(male, female); Diabetes (yes, no);	Revel race variable Chronic	
	Limited				pressure; diabetes	Systolic blood pressure (<120, 120-		
_	laboratory				mellitus; glomerular	129, 130-139, 140-149, 150-159,	Egidemiology Collaboration	
6	tests)	16	16	NI	filtration rate at baseline	≥160); eGFR (≥90, 75-89, 60-74) <sup>9</sup>	었 (CKDEPI) equation	NI
	Saranburu					Age (<45, 45-54, 55-59, ≥55); Sex	nge (health survey), sex	
	t, 2017 -				Age; sex; systolic blood	(male, female); Diabetes (yes, no);	(halth survey). Hypertension	
	Model 3				pressure; diabetes	Systolic blood pressure (<120, 120-	was defined as systolic blood	
	(derivation				mellitus; glomerular	129, 130-139, 140-149, 150-159,	ressure ≥ 140 mmHg or	
	Clinical +				filtration rate at baseline;	≥160); eGFR (≥90, 75-89, 60-74); Uric	di <b>a</b> stolic blood pressure ≥ 90	
	Full	22	20	NI	uric acid; hemoglobin	acid (>6 for female or >7 for male, ≤6	mmHg or use of oral	NI

f 94					В	MJ Open	36/bmjopen-202	
	laboratory tests)					for female or ≤7 for male); Hemoglobing (<12 for female or <13 for male, ≥12 for female or ≥13 for male)	and interest in the control of the	
6	Saranburu t, 2017 - Model 1 (validation Clinical only)	n/a	15	NI	Age; sex; systolic blood pressure; waist circumference; diabetes mellitus	(male, female); Waist circumference (≤80 for male or ≤90 for male, >80 for female or >90 for male); Diabetes (yes, no); Systolic blood pressure (<120, 120-129, 130-139, 140-149, 150-159, ≥160)	mg/dl or a positive history of diabetes. Waist circumference was measured midway between the lowest ribs and the iliac crest.	n/a
	Saranburu t, 2017 - Model 2		40		Age; sex; systolic blood pressure; diabetes mellitus; glomerular	Age (<45, 45-54, 55-59, ≥55); Sex (male, female); Diabetes (yes, no); Systolic blood pressure (<120, 120-	(health survey), sex (health survey). Hypertension was defined as systolic blood	
6	(validation	n/a	16	NI	filtration rate at baseline	129, 130-139, 140-149, 150-159,	ਰਾ ਰਾ ਸ਼੍ਰੇ ਸ਼੍ਰੇ	n/a

					В	MJ Open	36/bmjopen-202	F
	Clinical + Limited laboratory tests)			5		≥160); eGFR (≥90, 75-89, 60-74)	diestolic blood pressure ≥ 90 diest	
					r Deer	<b>O</b>	displayed a street of the stre	
7	Thakkinsti an, 2011 (derivation )	37	10	NI	Age; history of kidney stones; diabetes mellitus; hypertension		tests/physical examinations), hypertension (history of impess, relevant medicines used or laboratory tests/physical examinations), and history of kidney stones diself-reported in survey).	NI
8	Wen, 2020 - Simple Risk Score (derivation	NI	15	Time- varying	Waist circumference; systolic blood pressure; sex; education; diabetes		Dusing medical examinations, participants took two blood pressure measurements	NI

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						, <del>,</del>	<b>0</b> 2	
						t, including	(ilterate for 0 years, primary	
						udi	school for 1–6 years, junior	
						l g	high school for 7–9years, and	
						fo	Senior high school for ≥10	
						]	years); Sex was self-reported;	
						i di	Information about waist	
						l sa	_grcumference, C-reactive	
							Bratain and trialycarides were	
						s related	protein and triglycerides were no available	
						Age (≤ 40, 41–50, 51–60, 61–70, 9	no available  See (self-reported), gender	
						>71) gender (male, female) and hody	(FAT-reported) and hody mass	
	Wu, 2016				16	≥71), gender (male, female) and body mass index (BMI) status (normal,	Sex (RMI) status (calculated	
	(derivation				Age, gender and body	overweight: 23–24.9 kg/m2, obesity:	dram participant's measured	
9	(derivation	NI	10	Baseline	mass index (BMI) status.	>25 kg/m2)	n participant's measured	NI
9	,	INI	10	Daseillie	mass muex (Bivii) status.	≥25 kg/m2).	Organical fragerted gooder	INI
						71+), gender (male, female) and body	(self reported) and body mass	
	Wu, 2016					mana index (PMI) status (normal	in Pox (PMI) etetus (colouleted	
	(validation				Age, gender and body	averyoight: 22–24 0 kg/m2 shooity:	frem participant's massured	
9	(validation	n/a	10	Baseline	mass index (BMI) status.	mass index (BMI) status (normal, overweight: 23–24.9 kg/m2, obesity: ≥25 kg/m2).	hody weight and height)	n/a
3	,	11/a	10	Dasellile	mass much (Divil) status.	=25 kg/III2).	body weight and height).	Π/α
						raining, and similar technologies.	bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA	43
				Га	and roulous only between the contractions	non hmi som/sito/ahsvt/sv:dalinasvtt	•	-
				Forp	beer review only - http://bmJo	pen.bmj.com/site/about/guidelines.xhtml		

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# **S3.4 Table:** Sample size and missing data

			Sample Siz	ze g	21 on Mi		
N°	Study	Baselin e sample size	Number of outcome events	Total outcome events per candidate predictors	Mar Prodissing data	Number of participant s with missing data	Missing data per candidat e predictor s
1	Asgari, 2020 European Risk Assessment tool (6-years validation)	3270	722	n/a 🕺	& mplete-case	2817	n/a
1	Asgari, 2020 European Risk Assessment tool (9-years validation)	3240	1359		🖔 🕏 mplete-case	2847	n/a
2	Bradshaw, 2019 - Model 1 (derivation)	8698	947	31,57	mplete-case	896	29,87
2	Bradshaw, 2019 - Model 2 (derivation)	8698	947		Cemplete-case	896	38,96
2	Bradshaw, 2019 - Model 3a (derivation)	8698	947	NI	Cemplete-case	896	NI
2	Bradshaw, 2019 - Model 3b (derivation)	8698	947	<b>ي</b> 118,38	Cemplete-case	896	112,00
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	4065	NI	n/a 💃	Complete-case	1300	n/a
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	4940	NI	n/a	Complete-case	1233	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	2368	81	2,25	Complete-case	235	6,53
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	2368	81	غ، 3,12 غ	Complete-case	235	9,04
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	1459	79	n/a	Complete-case	79	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	1459	79	n/a 💆	Complete-case	79	n/a
4	Mogueo, 2015 - Korean model (eGFR validation)	902	259	n/a	Cemplete-case	383	n/a
4	Mogueo, 2015 - Thai model (eGFR validation)	902	259	n/a	Complete-case	383	n/a
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	902	268	n/a	Cemplete-case	383	n/a
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	902	268	n/a	Cemplete-case	383	n/a
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	2141	222	n/a 🧟	C <b>e</b> mplete-case	NI	n/a
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	2328	233	n/a 🥦	C <b>e</b> mplete-case	NI	n/a
6	Saranburut, 2017 - Model 1 (derivation Clinical only)	3186	271	18,07	Camplete-case	NI	NI
6	Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	3186	271	18,07	Cemplete-case	NI	NI
6	Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	3186	271	16,94	င်္ခြာmplete-case	NI	NI
6	Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	3186	271	12,32	Complete-case	NI	NI
6	Saranburut, 2017 - Model 1 (validation Clinical only)	1395	27	n/a	Camplete-case	NI	NI

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2022. Downloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Department GEZ-LTA ismushogeschool. ed to text and data mining, Al training, and similar technologies.

					<u> </u>		
6	Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	1395	27	n/a	Complete-case	NI	NI
7	Thakkinstian, 2011 (derivation)	3459	626		21 NI	NI	NI
8	Wen, 2020 - Simple Risk Score (derivation)	3266	590	NI S	Complete-case	992	NI
8	Wen, 2020 - Best-fit Risk Score (derivation)	3266	590	NI	Cemplete-case	992	NI
9	Wu, 2016 (derivation)	14374	294	l NI S	"Complete-case	3135	NI
9	Wu, 2016 (validation)	4371	48	n/a	∰ 🕏 Smplete-case	911	n/a
	Wu, 2016 (validation)				se control of the con		

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### S3.5 Table: Model development

				Mod	del Development	÷ 5
N°	Study	Regressio n method	Were the model assumptions verified?	Predictors selection	If the prediction model was a replication, which was the original model?	Was a shrinkage of the method
	Asgari, 2020 European Risk	<i></i>	,	,	,	es onlo
1	Assessment tool (6-years validation)	n/a	n/a	n/a	n/a	n/a n/a
1	Asgari, 2020 European Risk	n/a	n/a	n/a	n/a	#aoed 
'	Assessment tool (9-years validation)	II/a	II/a	II/a	g	Steg-down selection procedure
2	Bradshaw, 2019 - Model 1 (derivation)	Logistic	NI	Pre-selection	n/a	information criterion to select the final predictors
2	Bradshaw, 2019 - Model 2 (derivation)	Logistic	NI	Pre-selection	n/a	Step-down selection procedure by based on the Akaike information criterion to select the final predictors No
2	Bradshaw, 2019 - Model 3a (derivation)	Logistic	NI	Pre-selection		Step-down selection procedure based on the Akaike information criterion to select the final predictors No
2	Bradshaw, 2019 - Model 3b (derivation)	Logistic	NI	Pre-selection	n/a	Stee-down selection procedure by based on the Akaike information criterion to select the final predictors No
	Bradshaw, 2019 - Model 3a (CARRS-I					at ,
2	urban validation)	n/a	n/a	n/a	n/a	
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	n/a	n/a	n/a	n/a	n/a n/a epart n/a n/a
3	Carrillo-Larco, 2017 - CRONICAS- CKD (derivation complete)	Logistic	NI	Pre-selection	n/a	Steawise backward elimination method No

			ВМЈ	Open	:	36/bmjopen-2021	
	Carrillo-Larco, 2017 - CRONICAS-					Esterwise backward elimination	
3	CKD (derivation lab-free)	Logistic	NI	Pre-selection	n/a	method 588 method 221 on n/a	No
	Carrillo-Larco, 2017 - CRONICAS-					9 21	
3	CKD (validation complete)	n/a	n/a	n/a	n/a	n/a	n/a
	Carrillo-Larco, 2017 - CRONICAS-	,	,	,	,	15 M n/a	,
3	CKD (validation lab-free)	n/a	n/a	n/a	n/a	n/a n/a n/a march 20	n/a
,	Mogueo, 2015 - Korean model (eGFR	n/a	n/a	n/a	n/a	마다 n/a	n/a
4	validation)					ta z	
4	Mogueo, 2015 - Thai model (eGFR validation)	n/a	n/a	n/a	n/a	0022. n/a	n/a
4	Mogueo, 2015 - Korean model (eGFR						
4	or proteinuria validation)	n/a	n/a	n/a	n/a	books n/a n/a n/a	n/a
	Mogueo, 2015 - Thai model (eGFR or					<u> </u>	
4	proteinuria validation)	n/a	n/a	n/a	n/a	ochoo n/a	n/a
-	Saranburut, 2017 - Framingham Heart					<b>p</b> 2	
5	Study (MDRD validation)	n/a	n/a	n/a	n/a	Bi from n/a	n/a
	Saranburut, 2017 - Framingham Heart					g n	
5	Study (CKD-EPI validation)	n/a	n/a	n/a	n/a	n/a	n/a
6	Saranburut, 2017 - Model 1 (derivation Clinical only)	Logistic	NI	Pre-selection	n/a	Variables were sequentially added in a pre-specified order and incorporated using a p< 0.95 threshold for entry and retention in the final model	No
6	Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	Logistic	NI	Pre-selection	n/a	2. Variables were sequentially added in a pre-specified order and incorporated using a p           6         0.35 threshold for entry and recent and incorporated using a p	No
	Saranburut, 2017 - Model 2 (derivation					Variables were sequentially Padded in a pre-specified order and incorporated using a p<	
6	Clinical + Limited laboratory tests)	Logistic	NI	Pre-selection	n/a	reention in the final model	No
	Saranburut, 2017 - Model 3 (derivation					Variables were sequentially added in a pre-specified order and incorporated using a p< 0.25 threshold for entry and	
6	Clinical + Full laboratory tests)	Logistic	NI	Pre-selection	n/a	rention in the final model	No
		g.••	1		1	N	

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6	Saranburut, 2017 - Model 1 (validation Clinical only)	n/a	n/a	n/a	n/a	-058921	n/a
6	Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	n/a	n/a	n/a	n/a	er en n/a	n/a
		106	9er /6			Factors with p values < 0.15 in agunivariate analysis were considered to be accomply included in the distributivariate logistic equation. The del selection was performed by the selection	
7	Thakkinstian, 2011 (derivation)  Wen, 2020 - Simple Risk Score	Logistic	NI	Pre-selection	n/a	model.  PRist factors were investigated by forward stepwise logistic regression and only statiscally significant (a two-sided P value 0.05) risk factors were	No
8	(derivation)	Logistic	NI	Pre-selection	n/a	retained.  Risk factors were investigated by forward stepwise logistic gregression and only statiscally gign from the company of the company	No
8	Wen, 2020 - Best-fit Risk Score (derivation)	Logistic	NI	Pre-selection	n/a	" 3€0.05) risk factors were  □ retained.  S☐ pwise logistic regression  mo☐ Variables with a p value	No
9	Wu, 2016 (derivation)	Logistic	NI	Pre-selection	n/a	less than 0.1 were kept in the final model.	No
9	Wu, 2016 (validation)	n/a	n/a	n/a	n/a	G n/a	n/a

#### **S3.6 Table:** Model performance

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	ot applicable; NI: no information  Table: Model performan	ce		36/bmjopen-2021-058921 o by copyright, including fo Open		
				Model Performance US 05 N		
N°	Study	Calibration	Discrimination (%)	March 2022. Downloade Erasmushogeschoo es related to text and da ext and da Classification	Cut-off point	For replicati on studies, was the cut-off the same?
1	Asgari, 2020 European Risk Assessment tool (6- years validation)	Hosmer-Lemeshow X2 test (for intercept adjusted model): 13.53 with a p-value 0.09 (for male) and 10.1 with a p-value 0.26 (for women)	AUC (95% CI) for final intercept adjusted model = Male: 0.76 (0.72- 0.79) and Female: 0.71 (0.69-0.73)	Men: Sensitivity = 72.7%, Specificity = 65.6%. Women: Sensitivity = 66.8%, Specificity = 65.6%.	Men: 25. Women: 19	No
1	Asgari, 2020 European Risk Assessment tool (9- years validation)	Hosmer-Lemeshow X2 test (for intercept adjusted model): 12.54 with a p-value 0.13 (for male) and 8.19 with a p-value 0.41 (for women)	AUC (95% CI) for final intercept adjusted model = Male: 0.71 (0.67-0.74) and Female: 0.70 (0.68-0.73)	Men: Sensitivity = 64.5%, Specificity 69.5%. Women: Sensitivity = 56.9%, Specificity = 76.6%	Men: 25. Women: 23	No
2	Bradshaw, 2019 - Model 1 (derivation)	Calibration slope: 0.96	C-statistic (95% CI) = 0.79 (0.78-0.81)	Sensitivity = 72%, Specificity = 72%, PP\ 24%, NPV = 96%	0.09	n/a
2	Bradshaw, 2019 - Model 2 (derivation)	Calibration slope: 0.98	C-statistic (95% CI) = 0.73 (0.72-0.75)	Sensitivity = 68%, Specificity = 67%, PP\\ = 20%, NPV = 95%	0.09	n/a
2	Bradshaw, 2019 - Model 3a (derivation)	Calibration slope: 0.98	C-statistic (95% CI) = 0.77 (0.75-0.79)	Sensitivity = 71%, Specificity = 70%, PP = 22%, NPV = 95%	0.09	n/a
2	Bradshaw, 2019 - Model 3b (derivation)	Calibration slope: 0.99	C-statistic (95% CI) = 0.77 (0.76-0.79)	Sensitivity = 71%, Specificity = 70%, PP\2 = 22%, NPV = 95%	0.09	n/a

94			Вл	36/bmjopen-2021-058921 on d by copyright, including for Open		
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	NI	C-statistic (95% CI) = 0.74 (0.73-0.74)	021-058921 ; including	0.09	Yes
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	NI	C-statistic (95% CI) = 0.70 (0.69-0.71)	15 M uses Z	0.09	Yes
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Hosmer-Lemeshow X2 test: 4.13 with a p-value of 0.53 (for final multivariable model).	AUC = 76.2%	NI SM  Relation 2029  Sensibility = 82.5%, Specificity = 70.9%, PPV = 8.8%,  NPV = 99.1%, LHR+ = 2.8, L96-0.3	2	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	Hosmer-Lemeshow X2 test: 4.13 with a p-value of 0.53 (for final multivariable model).	AUC = 76%	Sensibility = 80.0%, Specificity = 72.0%, PPV = 9.1%, NPV = 99.0%, LHR+ = 2.9, LBR-0-0.3	2	n/a
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	NI	AUC = 70.0%.	Sensitivity = 70.5%, Specificity = 69.1%, PV = 11.4%, NPV = 97.6%, LHR+ = 2.3, LHR- 0.4	2	Yes
3	Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	NI	AUC = 70.0%.	Sensitivity = 70.5%, Specificity = 69.7%, PPV = 11.6%, NPV = 97.7%, LHR+ = 2.3, LPR	2	Yes
4	Mogueo, 2015 - Korean model (eGFR validation)	Expected/Observed rate (95%) = 0.76 (0.67-0.86); Brier score = 0.164; Yates slope = 0.208	C-statistic (95% CI) = 0.797 (0.765- 0.829)	.bmj.com/ oand similar oand similar oand similar oand oand oand oand oand oand oand oand	0.30	NI
4	Mogueo, 2015 - Thai model (eGFR validation)	Expected/Observed rate (95%) = 0.98 (0.87-1.10); Brier score = 0.165; Yates slope = 0.200	C-statistic (95% CI) = 0.760 (0.726- 0.793)	May 13, 2022 Sensitivity = 73%, Specificity = 22%	0.31	NI
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Expected/Observed rate (95%) = 0.76 (0.67-0.85); Brier score = 0.161; Yates slope = 0.225	C-statistic (95% CI) = 0.811 (0.780- 0.842)	Sensitivity = 84%, Specificity = 68%	0.31	NI

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		Expected/Observed rate (95%) = 0.97		2021-058921 nt, including		
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	(0.86-1.09); Brier score = 0.164; Yates slope = 0.211	C-statistic (95% CI) = 0.772 (0.739- 0.805)	Sensitivity = 74%, Specificit <b>y</b> = 78%	0.32	NI
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	Hosmer-Lemeshow X2 test: 30.2 (p<0.001)	AUC (95% CI) = 0.69 (0.66-0.73)	S March Era ses relat	NI	NI
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Hosmer-Lemeshow X2 test: 256.5 (p<0.001)	AUC (95% CI) = 0.63 (0.57-0.65)	2022. Do as musho texto	NI	NI
	Saranburut, 2017 - Model 1 (derivation Clinical	Hosmer-Lemeshow X2 test: 9.02	AUC (95% CI) =	wnloa gesch and		
6	only) Saranburut, 2017 - Model 1 BMI (derivation Clinical	(p=0.34) Hosmer-Lemeshow X2 test: 8.87	0.72 (0.69-0.75) AUC (95% CI) =	Naded from data minin	NI	n/a
6	only) Saranburut, 2017 - Model 2 (derivation Clinical +	(p=0.35) Hosmer-Lemeshow X2 test: 10.87	0.72 (0.69-0.75) AUC (95% CI) =	<u> </u>	NI	n/a
6	Limited laboratory tests) Saranburut, 2017 - Model 3 (derivation Clinical +	(p=0.21) Hosmer-Lemeshow X2 test: 8.28	0.79 (0.76-0.82) AUC (95% CI) =	p://bmjope	NI	n/a
6	Full laboratory tests)	(p=0.41) Hosmer-Lemeshow	0.80 (0.77-0.82)	NI and si	NI	n/a
6	Saranburut, 2017 - Model 1 (validation Clinical only) Saranburut, 2017 - Model	X2 test: 4.31 (p=0.229) Hosmer-Lemeshow	AUC (95% CI) = 0.66 (0.55-0.78)	om/ om/ omilar	NI	NI
6	2 (validation Clinical + Limited laboratory tests)	X2 test: 2.29 (p=0.514)	AUC (95% CI) = 0.88 (0.80-0.95)	on May 13, 20; technologies ≥	NI	NI
		Calibration was assessed by subtracting the two Somer's D		. 25		
	Thakkinstian, 2011	correlation coefficients: 0.045 (95% CI: 0.034-	C-statistic of internal	at Departn		
7	(derivation)	0.057)	validation = 0.741	Sensitivity = 76%, Specificity = 9%	5	n/a

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94			BN	Sensitivity = 70.49%, Specificity = \$5.18	36/km jonen d					
	Wen, 2020 - Simple Risk	Hosmer-Lemeshow X2 test: 4.89	AUC (95% CI) =	Sensitivity = 70.49%. Specificity = <b>8</b> 5.18	99 90 90 90 90 90 90 90 90 90 90 90 90 9					
8	Score (derivation)	(p=0.769)	0.717 (0.689-0.744)	29.8%, NPV = 91.3%, LHR+ = 2.0 <b>2</b> , LE	<b>X</b> R- = 0.45	14	n/a			
8	Wen, 2020 - Best-fit Risk Score (derivation)	Hosmer-Lemeshow X2 test: 2.52 (p=0.961)	AUC (95% CI) = 0.721 (0.693-0.748)	ଦି ହ Sensitivity = 56.83%, Specificity = <b>୮</b> 6.6 33.8%, NPV = 89.4%, LHR+ = 2.4 <b>%</b> , L	<b>∱</b> %, PPV = <b></b>	24	n/a			
9	Wu, 2016 (derivation)	Internal validation dataset: Hosmer- Lemeshow X2 test P=0.798	AUC (95% CI) of internal validation = 0.894 (0.861-0.926)	Sensitivity = 0.820, Specificity	85 863	36	n/a			
9	Wu, 2016 (validation)	Hosmer-Lemeshow	AUC = 0.880 (95%CI: 0.829-	e hoges of and		NI	NI			
	9 Wu, 2016 (validation) X2 test P=397  AUC, area under the curve; CI, confident interval; NI, no information.  AUC, area under the curve; CI, confident interval; NI, no information.  AUC, area under the curve; CI, confident interval; NI, no information.  AUC, area under the curve; CI, confident interval; NI, no information.  AUC, area under the curve; CI, confident interval; NI, no information.  AUC, area under the curve; CI, confident interval; NI, no information.  NI N									
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	=						
		Results					
N°	Study	Was a simplified model presente d?	Were the coefficien ts of the regressio n model presente d?	Was the baseline risk presente d?	Were there alternative results presentati on?		
	Asgari, 2020 European						
1	Risk Assessment tool (6-years validation)	No	No	Yes	No		
<u>'</u>	Asgari, 2020 European	NO	INO	163	110		
	Risk Assessment tool						
1	(9-years validation)	No	No	Yes	No		
_	Bradshaw, 2019 -	V	NI-	NI-	NI-		
2	Model 1 (derivation)  Bradshaw, 2019 -	Yes	No	No	No		
2	Model 2 (derivation)	Yes	No	No	No		
	Bradshaw, 2019 -			1.0			
2	Model 3a (derivation)	No	No	No	No		
	Bradshaw, 2019 -						
2	Model 3b (derivation)	Yes	No	No	No		
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	No	No	No	No		
	Bradshaw, 2019 -	INU	INU	INU	INO		
	Model 3a (UDAY rural						
2	validation)	No	No	No	No		
	Carrillo-Larco, 2017 -						
3	CRONICAS-CKD	Voo	Yes	No	No		
<u>ა</u>	(derivation complete) Carrillo-Larco, 2017 -	Yes	res	INO	INO		
3	CRONICAS-CKD (derivation lab-free)	No	Yes	No	No		
	Carrillo-Larco, 2017 -						
3	CRONICAS-CKD	Voo	No	No	No		
ა	(validation complete) Carrillo-Larco, 2017 -	Yes	No	INO	No		
	CRONICAS-CKD						
3	(validation lab-free)	No	No	No	No		
	Mogueo, 2015 - Korean						
4	model (eGFR	NI -	NI-	NJ-	NI-		
4	validation) Mogueo, 2015 - Thai	No	No	No	No		
	model (eGFR						
4	validation)	No	No	No	No		
	Mogueo, 2015 - Korean						
	model (eGFR or	<b>N</b> 1.	A.L.	A.L.	NI.		
4	proteinuria validation)	No	No	No	No		
	Mogueo, 2015 - Thai model (eGFR or						
4	proteinuria validation)	No	No	No	No		
	Saranburut, 2017 -						
5	Framingham Heart	No	Yes	No	No		

Study (MDRD validation)  Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)  Saranburut, 2017 - Model 1 (derivation Clinical only)  Saranburut, 2017 - odel 1 BMI (derivation Clinical only)  Saranburut, 2017 - Model 2 (derivation	No No	Yes Yes	No No	No Yes
Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation) Saranburut, 2017 - Model 1 (derivation Clinical only) Saranburut, 2017 - odel 1 BMI (derivation Clinical only) Saranburut, 2017 -	No	Yes		
Framingham Heart Study (CKD-EPI validation)  Saranburut, 2017 - Model 1 (derivation Clinical only)  Saranburut, 2017 - odel 1 BMI (derivation Clinical only)  Saranburut, 2017 -	No	Yes		
Study (CKD-EPI validation)  Saranburut, 2017 - Model 1 (derivation Clinical only)  Saranburut, 2017 - odel 1 BMI (derivation Clinical only)  Saranburut, 2017 -	No	Yes		
validation) Saranburut, 2017 - Model 1 (derivation Clinical only) Saranburut, 2017 - odel 1 BMI (derivation Clinical only) Saranburut, 2017 -	No	Yes		
Saranburut, 2017 - Model 1 (derivation Clinical only) Saranburut, 2017 - odel 1 BMI (derivation Clinical only) Saranburut, 2017 -	No	Yes		
Model 1 (derivation Clinical only) Saranburut, 2017 - odel 1 BMI (derivation Clinical only) Saranburut, 2017 -			No	Yes
Clinical only) Saranburut, 2017 - odel 1 BMI (derivation Clinical only) Saranburut, 2017 -			No	Yes
Saranburut, 2017 - odel 1 BMI (derivation Clinical only) Saranburut, 2017 -	No			
Clinical only) Saranburut, 2017 -	No		1	
Saranburut, 2017 -	No			
		No	No	Yes
Model 2 (derivation				
Clinical + Limited	V.	V.	N.L.	
laboratory tests)	Yes	Yes	No	Yes
	Yes	Yes	No	No
	103	103	110	110
•				
Clinical only)	No	No	No	Yes
Saranburut, 2017 -				
Model 2 (validation				
	Yes	No	No	Yes
· ·				
	No	Yes	No	Yes
	Nia	Vac	Vaa	Vaa
	INO	Yes	res	Yes
	No	Voc	Voc	Yes
				Yes
vu, 2016 (validation)	INO	res	INO	Yes
	Saranburut, 2017 -	Model 3 (derivation inical + Full laboratory tests)  Saranburut, 2017 - Model 1 (validation Clinical only)  Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)  Thakkinstian, 2011 (derivation)  Wen, 2020 - Simple isk Score (derivation)  Wen, 2020 - Best-fit isk Score (derivation)  No Wu, 2016 (derivation)  No Wu, 2016 (derivation)	Model 3 (derivation inical + Full laboratory tests)  Saranburut, 2017 - Model 1 (validation Clinical only)  No No Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)  Thakkinstian, 2011 (derivation)  Wen, 2020 - Simple isk Score (derivation)  Wen, 2020 - Best-fit isk Score (derivation)  No Yes  Vu, 2016 (derivation)  No Yes	Model 3 (derivation inical + Full laboratory tests)  Saranburut, 2017 - Model 1 (validation Clinical only)  No No No No Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)  Thakkinstian, 2011 (derivation)  Wen, 2020 - Simple isk Score (derivation)  Wen, 2020 - Best-fit isk Score (derivation)  No Yes Yes  Vu, 2016 (derivation)  No Yes No

# S3.8 Table: Discussion

			Discussion	
N°	Study	Interpretation of the results	Comparison with other studies in LAC	Generalizability
1	Asgari, 2020 European Risk Assessment tool (6-years validation)	Exploratory	No	Non- generalizability
1	Asgari, 2020 European Risk Assessment tool (9-years validation)	Exploratory	No	Non- generalizability
2	Bradshaw, 2019 - Model 1 (derivation)	NI	No	NI
2	Bradshaw, 2019 - Model 2 (derivation)	NI	No	NI
2	Bradshaw, 2019 - Model 3a (derivation)	Confirmatory	Yes	Non- generalizability
2	Bradshaw, 2019 - Model 3b (derivation)	NI	No	NI
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Confirmatory	Yes	Non- generalizability
2	Bradshaw, 2019 - Model 3a (UDAY rural validation)	Confirmatory	Yes	Non- generalizability
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Exploratory	Yes	Generalizable
3	Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free) Carrillo-Larco, 2017 - CRONICAS-CKD	Exploratory	Yes	Generalizable
3	(validation complete)  Carrillo-Larco, 2017 - CRONICAS-CKD	Exploratory	Yes	Generalizable
3	(validation lab-free)  Mogueo, 2015 - Korean model (eGFR	Exploratory	Yes	Generalizable Non-
4	validation)  Mogueo, 2015 - Thai model (eGFR	Exploratory	Yes	generalizability  Non-
4	validation)	Exploratory	Yes	generalizability
4	Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Exploratory	Yes	Non- generalizability
4	Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Exploratory	Yes	Non- generalizability
5	Saranburut, 2017 - Framingham Heart Study (MDRD validation)	Exploratory	No	Non- generalizability
5	Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Exploratory	No	Non- generalizability
6	Saranburut, 2017 - Model 1 (derivation Clinical only) Saranburut, 2017 - Model 1 BMI	Exploratory	No	Non- generalizability Non-
6	(derivation Clinical only)  Saranburut, 2017 - Model 2 (derivation	Exploratory	No	generalizability  Non-
6	Clinical + Limited laboratory tests)  Saranburut, 2017 - Model 3 (derivation	Exploratory	No	generalizability  Non-
6	Clinical + Full laboratory tests)  Saranburut, 2017 - Model 1 (validation	Exploratory	No	generalizability Non-
6	Clinical only)  Saranburut, 2017 - Model 2 (validation	Exploratory	No	generalizability  Non-
6	Clinical + Limited laboratory tests)	Exploratory	No	generalizability  Non-
7	Thakkinstian, 2011 (derivation)	Confirmatory	No	generalizability

	Wen, 2020 - Simple Risk Score			Non-
8	(derivation)	Confirmatory	Yes	generalizability
	Wen, 2020 - Best-fit Risk Score			Non-
8	(derivation)	Exploratory	Yes	generalizability
				Non-
9	Wu, 2016 (derivation)	Exploratory	No	generalizability
				Non-
9	Wu, 2016 (validation)	Exploratory	No	generalizability



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**S4 Table: PROBAST** 

S4.1 Table: Risk of Bias (RoB)

	Partici	pants	Mai es r	Predictors	
Study	Were appropriate data sources used, e.g., cohort, RCT, or nested case-control study data?	Were all inclusions and exclusions of participants appropriate?	The 2022. Downloaded Erasming house of the text and defined defined defined assessed as similar wastericipal and participal an	Were predictor assessments made without knowledge of outcome data?	Are all predictors available at the time the model is intended to be used?
Asgari, 2020 European Risk Assessment tool (6-years validation)	Y	Υ	I from	Υ	Υ
Asgari, 2020 European Risk Assessment tool (9-years validation)	Y	Υ	ng, A	Υ	Υ
Bradshaw, 2019 - Model 1 (derivation)	Υ	Y	//bn   tra   ~	Υ	PY
Bradshaw, 2019 - Model 2 (derivation)	Υ	Y	ining,	Υ	Υ
Bradshaw, 2019 - Model 3a (derivation)	Υ	Y	en.l g, a Y	Υ	PY
Bradshaw, 2019 - Model 3b (derivation)	Υ	Y	Y nd s	Υ	PY
Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Υ	Υ	Y simi	Υ	PY
Bradshaw, 2019 - Model 3a (UDAY rural validation)	Υ	Y	Y or	Υ	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Υ	Y	n Ma ech Y	Υ	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	Υ	Y	y nole	Υ	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	Υ	Y	3, 202 ogies. > >	Υ	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	Υ	Y	025 's. 'Y	Υ	Y
Mogueo, 2015 - Korean model (eGFR validation)	Υ	Y	at [ Y	Υ	PY
Mogueo, 2015 - Thai model (eGFR validation)	Υ	Y	Y epa	Υ	Υ
Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Υ	Y	Y	Υ	PY
Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Y	Y	Y	Υ	Y

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			en-2021 right, in		
Saranburut, 2017 - Framingham Heart Study (MDRD validation)	Υ	Υ	-058 clue >	Υ	PY
Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Υ	Υ	3921 c sling fo >		PY
Saranburut, 2017 - Model 1 (derivation Clinical only)	Υ	Υ	on 15 or uso		Υ
Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	Υ	Y	ses Y		Υ
Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	Υ	Y	erch 2022. Erasmus related to > > >	Υ	PY
Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	Υ	Υ	<del>+</del> <u>*'</u> _	Υ	PY
Saranburut, 2017 - Model 1 (validation Clinical only)	Υ	Y	hog hog ext	Υ	Υ
Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	Υ	Υ	nloadescho	Υ	PY
Thakkinstian, 2011 (derivation)	Υ	Υ	Y ata	Υ	Υ
Wen, 2020 - Simple Risk Score (derivation)	Υ	Y	fron min Y	Υ	Y
Wen, 2020 - Best-fit Risk Score (derivation)	Υ	Y	ing,	Υ	Υ
Wu, 2016 (derivation)	Y	Y	Y <b>≥</b> ₹	Υ	Y
Wu, 2016 (validation)	Υ	Y	om (rai 	Υ	Y
Answer options: Y (yes), PY (probably yes), N (no), PN (probably no), NI (no inform	папоп), п/а (погаррпса	able).	bmjopen.bmj.com/ on May 13, 20; raining, and similar technologies >		
			jopen.bmj.com/ on May 13, 2025 at Departn ning, and similar technologies.		
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	ВМЈ Оре					
Study	Was the outcome determined appropriately?	Was a prespecified or standard outcome definition used?	Were predictors excluded from the outcome definition?	come e de	Was the outcome determined without knowledge of predictor information?	Was the time interval between predictor assessment and outcome determination appropriate?
Asgari, 2020 European Risk Assessment tool (6-years validation)	Y	Y	Y	nloadec esshool and data	NI	Y
Asgari, 2020 European Risk Assessment tool (9-years validation)	CA.	Y	Y	from h	NI	Y
Bradshaw, 2019 - Model 1 (derivation)	Y	Y	Y	A A A	NI	PY
Bradshaw, 2019 - Model 2 (derivation)	Y	Y	Υ	ttp://bmjope	NI	Y
Bradshaw, 2019 - Model 3a (derivation)	NI	Y	Υ	y y g, an	NI	PY
Bradshaw, 2019 - Model 3b (derivation)	Y	Υ	Y	nj.com Y Sim	NI	PY
Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Y	Y	Υ	n/ on Y ilar te	NI	PY
Bradshaw, 2019 - Model 3a (UDAY rural validation)	Y	Y	Υ	May .	NI	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	Υ	Y	Y	13, 2025 } logies.	PY	PY
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab- free)	Υ	Y	Y	at Depa	PY	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	Y	Y	Y	Y GE	PY	PY

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Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab- free)	Υ	Y	Y	21-05892 > including	PY	Y
Mogueo, 2015 - Korean model (eGFR validation)	Y	Y	Y	₫Y q	NI	PY
Mogueo, 2015 - Thai model (eGFR validation)	Y	Y	Y	us es r	NI	Y
Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Y	Y	Y	rch 2022 Erasmu elated to	NI	PY
Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Υ	Υ	Υ	Downle hysges text an	NI	Υ
Saranburut, 2017 - Framingham Heart Study (MDRD validation)	e Y	Y	Y	aded fr hool . data m	NI	PY
Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Y	Y	Y	from http: mining, A	NI	PY
Saranburut, 2017 - Model 1 (derivation Clinical only)	Y	Y	Y	Y Y trair	NI	Y
Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	Y	Y	Υ	ing,	NI	Y
Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	Υ	Υ	Y	n.bmj.com/ on May 13, 202	NI	PY
Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	Y	Y	Y	on Ma	NI	PY
Saranburut, 2017 - Model 1 (validation Clinical only)	Y	Y	Y	n May 13,	NI	Y
Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	Y	Y	Y	2025 at >- yles.	NI	PY
Thakkinstian, 2011 (derivation)	Υ	Y	Y	) Y	NI	Y
Wen, 2020 - Simple Risk Score (derivation)	Y	Y	Y	yrtmert Y	NI	Y

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Wen, 2020 - Best-fit Risk Score (derivation)	Y	Y	Y	21-058921 Y ncluding	NI	Y
Wu, 2016 (derivation)	Y	Y	Y	21-058921 or Y Y ncluding for	NI	Y
Wu, 2016 (validation)	Y	Y	Y	us Y	NI	Y
Answer options: Y (yes), PY (probably yes), N (no), PN (probably no), N	ii (no information), n/a (	not applicable).		larch 2022. Downloaded from http://bmjopen.bmj.com/ on May 13, 2025 at Departm Erasmushogeschool . 3 related to text and data mining, Al training, and similar technologies.		

			ВМЈ	Open	Analysis	by copyright, including fo	36/bm iopen-2021-058 <b>9</b> 21 o		
Study	Were there a reasonabl e number of participan ts with the outcome?	Were continuou s and categorical predictors handled appropriat ely?	Were all enrolled participan ts included in the analysis?	Were participants with missing data handled appropriatel y?	Was selection of predictors based on univariabl e analysis avoided? [develop ment studies only]	Werestiti es in the data (et al. censor the complexity and the censor that the censor the censor that the censor t	Were Were Were Were Were Were Were Were	Were model overfittin g and optimism in model performa nce accounte d for? [develop ment studies only]	Do predictors and their assigned weights in the final model correspond to the results from the reported multivariable analysis? [developmen t studies only]
Asgari, 2020 European Risk Assessment tool (6-years validation)	Y	Y	N	N	n/a	and sim	N N	n/a	n/a
Asgari, 2020 European Risk Assessment tool (9-years validation)	Y	Y	N	N	n/a		Z Z	n/a	n/a
Bradshaw, 2019 - Model 1 (derivation)	Y	N	N	N	N		Y 13	Y	NI
Bradshaw, 2019 - Model 2 (derivation)	Y	N	N	N	N	NI es.	>	Y	NI
Bradshaw, 2019 - Model 3a (derivation)	NI	NI	N	N	N		Y Art Du	Y	NI
Bradshaw, 2019 - Model 3b (derivation)	Y	N	N	N	N		Y	Y	NI
Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	NI	Υ	N	N	n/a	NI	Z Z	n/a	n/a

			ВМЈ (	Open		by copyright, including	36/bm ionon 201		
Bradshaw, 2019 - Model 3a (UDAY rural validation)	NI	Υ	N	N	n/a	including Z	NI NI	n/a	n/a
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation complete)	N	N	N	N	N	for use: Z	S N	Υ	Υ
Carrillo-Larco, 2017 - CRONICAS-CKD (derivation lab-free)	N	N	N	N	N	Erasmushoge s related to text a Z Z	N N	Y	Y
Carrillo-Larco, 2017 - CRONICAS-CKD (validation complete)	N	Υ	N	N	n/a	nushoge to text a Z	N N	n/a	n/a
Carrillo-Larco, 2017 - CRONICAS-CKD (validation lab-free)	N	OY	Ν	Ν	n/a	school nd data Z	N N	n/a	n/a
Mogueo, 2015 - Korean model (eGFR validation)	Υ	Y	N	Ν	n/a	mining, Z	PY	n/a	n/a
Mogueo, 2015 - Thai model (eGFR validation)	Υ	Υ	N	N	n/a	Al train 궁	PY	n/a	n/a
Mogueo, 2015 - Korean model (eGFR or proteinuria validation)	Υ	Υ	Ν	N	n/a	ing, and Z	PY	n/a	n/a
Mogueo, 2015 - Thai model (eGFR or proteinuria validation)	Υ	Υ	Ν	N	n/a	similar Z	PY	n/a	n/a
Saranburut, 2017 - Framingham Heart Study (MDRD validation)	Υ	Υ	Ν	Ν	n/a	technol	_	n/a	n/a
Saranburut, 2017 - Framingham Heart Study (CKD-EPI validation)	Υ	Υ	N	N	n/a		3 2025 N	n/a	n/a
Saranburut, 2017 - Model 1 (derivation Clinical only)	PY	N	N	N	N	NΙ	N	Y	Y
Saranburut, 2017 - Model 1 BMI (derivation Clinical only)	PY	N	N	N	N	NI	N N	Y	NI

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similar technologies.

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Saranburut, 2017 - Model 2 (derivation Clinical + Limited laboratory tests)	PY	N	N	N	N	ncluding Z	1.05.0 N	Y	Y
Saranburut, 2017 - Model 3 (derivation Clinical + Full laboratory tests)	PN	N	N	N	N	for uses	S N	Y	Υ
Saranburut, 2017 - Model 1 (validation Clinical only)	N	Y	N	N	n/a	Erasr s related Z	N N	n/a	n/a
Saranburut, 2017 - Model 2 (validation Clinical + Limited laboratory tests)	N	Y	N	N	n/a	nushog to text Z	N N	n/a	n/a
Thakkinstian, 2011 (derivation)	PY	N	NI	NI	N	scho nd d	N	Y	Y
Wen, 2020 - Simple Risk Score (derivation)	NI	N	N	N	N	eschool . and data mini Z Z	N	N	Y
Wen, 2020 - Best-fit Risk Score (derivation)	NI	Ν	N	N	N	ng, Altr		Ζ	Y
Wu, 2016 (derivation)	NI	N	N	N	N	ainin N	. N	N	Y
Wu, 2016 (validation)	N	Y	N	N	n/a	y, and	N	n/a	Y

Answer options: Y (yes), PY (probably yes), N (no), PN (probably no), NI (no information), n/a (not applicable).

## S4.2 Table: Applicability

		<u> </u>		
N°	Study	Participants	Predictors	Outcome
	Asgari, 2020 European Risk Assessment			
1	tool (6-years validation)	Low	Low	Low
	Asgari, 2020 European Risk Assessment			
1	tool (9-years validation)	Low	Low	Low
2	Bradshaw, 2019 - Model 1 (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 2 (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3a (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3b (derivation)	Low	Low	Low
2	Bradshaw, 2019 - Model 3a (CARRS-I urban validation)	Low	Low	Low
_	Bradshaw, 2019 - Model 3a (UDAY rural	Law	L	Law
2	validation) Carrillo-Larco, 2017 - CRONICAS-CKD	Low	Low	Low
3	(derivation complete)	Low	Low	Low
	Carrillo-Larco, 2017 - CRONICAS-CKD	2011	Low	2011
3	(derivation lab-free)	Low	Low	Low
	Carrillo-Larco, 2017 - CRONICAS-CKD			
3	(validation complete)	Low	Low	Low
	Carrillo-Larco, 2017 - CRONICAS-CKD			
3	(validation lab-free)	Low	Low	Low
4	Mogueo, 2015 - Korean model (eGFR validation)	Low	Low	Low
1	Mogueo, 2015 - Thai model (eGFR validation)	Low	Low	Low
4	Mogueo, 2015 - Korean model (eGFR or	LOW	Low	Low
4	proteinuria validation)	Low	Low	Low
	Mogueo, 2015 - Thai model (eGFR or			
4	proteinuria validation)	Low	Low	Low
	Saranburut, 2017 - Framingham Heart			
5	Study (MDRD validation)	Low	Low	Low
_	Saranburut, 2017 - Framingham Heart			
5	Study (CKD-EPI validation)	Low	Low	Low
	Saranburut, 2017 - Model 1 (derivation	Laur	1.4.	1
6	Clinical only) Saranburut, 2017 - Model 1 BMI	Low	Low	Low
6	(derivation Clinical only)	Low	Low	Low
	Saranburut, 2017 - Model 2 (derivation	LOW	LOW	LOW
6	Clinical + Limited laboratory tests)	Low	Low	Low
	Saranburut, 2017 - Model 3 (derivation	-		-
6	Clinical + Full laboratory tests)	Low	Low	Low
	Saranburut, 2017 - Model 1 (validation			
6	Clinical only)	Low	Low	Low
	Saranburut, 2017 - Model 2 (validation			
6	Clinical + Limited laboratory tests)	Low	Low	Low
7	Thakkinstian, 2011 (derivation)	Low	Low	Low
0	Wen, 2020 - Simple Risk Score	Low	l com	Low
8	(derivation) Wen, 2020 - Best-fit Risk Score	Low	Low	Low
8	(derivation)	Low	Low	Low
9	Wu, 2016 (derivation)	Low	Low	Low
	**4, 2010 (doilyation)	LOW		LOW

9	Wu, 2016 (validation)	Low	Low	Low		
Answer options: Low (low concern for applicability), Hig (High concern for applicability) and Unclear (Unclear concern for						
applicability)						

## S1 Figure: Countries where studies were conducted.

