Supplementary Information (SI)

Validation of the STOP-Bang Questionnaire for screening of obstructive sleep apnea in the general population and commercial drivers: a systematic review and meta-analysis

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Appendix 1. Search history record for systematic review: STOP-BANG questionnaire screening tool

| Databases                                      | Database Dates covered | Date Database was searched | # Citations | # Duplicate Citations | Total Citations remaining | Notes or Comments                  |
|------------------------------------------------|------------------------|----------------------------|-------------|----------------------|---------------------------|-----------------------------------|
| Medline/MedlineALL (Ovid)                      | 1946 – March 26, 2020  | March 30, 2020             | 396         |                      |                           |                                   |
| Embase (Ovid)                                  | 1947 – March 27, 2020  | March 30, 2020             | 763         |                      |                           |                                   |
| EmCare Nursing (Ovid)                          | 1995 – present         | March 30, 2020             | 9           |                      |                           |                                   |
| Cochrane Central Register of Controlled Trials (Ovid) | 1991 – present         | March 30, 2020             | 37          |                      |                           |                                   |
| Cochrane Database of Systematic Reviews (Ovid)  | 2005 – present         | March 30, 2020             | 0           |                      |                           |                                   |
| APA PsycINFO (Ovid)                            | 1806 – March Week #4, 2020 | March 30, 2020         | 100         |                      |                           |                                   |
| Journals@Ovid via University of Toronto (full-text searching) | March 30 2020        | March 30, 2020             | 689         |                      |                           |                                   |
| Web of Science (Clarivate) including citation search (Chung, Anesthesiology 2008, 812) | 1900 – March 27, 2020 | March 30, 2020             | 1127        |                      |                           |                                   |
| Scopus (Elsevier)                              | 1960 – present         | March 30, 2020             | 474         |                      |                           |                                   |
| CINAHL with Full Text (EbscoHost)              | 1982 – present         | March 30, 2020             | 276         |                      |                           |                                   |
| Totals:                                       |                        |                            | 3871        | 0                    | 0                         | Results in a compressed EndNote Library |

Review/Search Topic: STOP-BANG Questionnaire Screening Tool; years = >2008; no other limits applied

Searcher: Marina Englesakis

Investigator(s): Dr. Frances Chung, Rida Waseem, Anesthesia TWH

Date: Monday, March 30, 2020
| Study ID          | Use of STOP-Bang (SB)                                                                 | n       | High risk STOP-Bang ≥ 3 | Low risk STOP-Bang 0-2 | Reasons for exclusion                                      |
|------------------|---------------------------------------------------------------------------------------|---------|-------------------------|------------------------|-----------------------------------------------------------|
| Kunisaki[36] 2014 | Referred to sleep clinic from Veteran Affairs health care provider                     | American 1196 | 1170                    | 26                     | Wrong patient population                                   |
| Lockhart[37] 2015 | Volunteer from outpatient clinics or inpatient antepartum obstetric service           | American 248 | 48                      | 200                    | Wrong patient population                                   |
| Tantrakul[38] 2015 | High-risk pregnancy clinic                                                             | Thai 72  | 19                      | 53                     | Wrong patient population and BMI > 27.5                   |
| Evans[29] 2017   | Commercial drivers presenting for DOT (Department of Transportation) physical examinations | American 12 | 11                      | 1                      | Wrong publication type: a quality improvement project including validation with small sample size |
| Nahapetian[33] 2017 | Tested weighted STOP-Bang in derivation and validation groups from the Sleep Heart Study | American 4774 | NA                      | NA                     | Wrong patient population: same population as Silva” 2011 and inadequate information |
| Rebelo-Marques[34] 2017 | Validated STOP-Bang in patients referred to sleep clinic from primary care          | Portuguese 259 | 243                     | 16                     | Wrong patient population: patients had suspected sleep disorders |
| Cruces-Artero[28] 2019 | Multicenter, primary care: convenience sampling                                       | Spanish 178 | 65                      | 113                    | Different high-risk STOP-Bang cut-off: STOP-Bang ≥ 4 for females and ≥ 6 for males |
| Jeon[30] 2019    | Validated STOP-Bang in community-dwelling sample recruited through advertisements     | Korean 116 | 50                      | 66                     | Use of modified STOP-Bang: BMI > 30                       |
| Senaratna[35] 2019 | Validated STOP-Bang in randomly invited subjects from the Tasmanian Longitudinal Health Study, with OSA symptoms | Australian 286 | 206                     | 80                     | Use of ODI (oxygen desaturation index) instead of AHI     |
| Martins[31] 2020 | Validated STOP-Bang in community-dwelling adults aged 65+                             | Brazilian 458 | 417 (<2)                | 41 (<2)                | Different high-risk STOP-Bang cut-off: STOP-Bang ≥ 2 because all subjects were 50+ years old |
| Massongo[32] 2020 | Validated STOP-Bang in randomly selected community sample                             | Cameroonian 102 | 74                      | 28                     | Use of modified STOP-Bang: BMI > 30                       |
**Supplementary Table 2. Appraisal of the included studies based on criteria for internal validity**

| Internal Criteria | Valid reference standard | Definition of the disease based on reference standard | Blind execution of index test and reference test | Index test interpreted independently of clinical information | Study design |
|-------------------|--------------------------|-------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------|--------------|
| **Definition**    | Laboratory PSG or Home Sleep Apnea Test (HSAT) | OSA diagnosed based on the PSG results (F) | PSG readings blinded to the questionnaire results and vice versa (F) | The questionnaire interpreted independently of clinical information (F) | Prospective or Retrospective |
| **General population** | | | | | |
| Silva [39] 2011 | HSAT | F | U | U | Retrospective |
| Marti-Soler [40] 2016 | HSAT | F | F | U | Prospective |
| Tan [41] 2016 | HSAT | F | F | U | Prospective |
| Saldías Peñafiel [42] 2019 | HSAT | F | F | U | Prospective |
| Bauters [43] 2020 | HSAT | F | F | U | Prospective |
| **Commercial Drivers and Pilots** | | | | | |
| Firat [44] 2012 | Lab PSG | F | F | U | Prospective |
| Popević [45] 2017 | Lab PSG, HSAT in lab | F | U | U | Prospective |

F: Full meeting criteria; P: Partially meeting criteria; U: Unsure if meeting criteria in subgroups; N/A: Not applicable
### Supplementary Table 3. Appraisal of the included studies based on criteria for external validity

| External Criteria | Spectrum of diseases | Settings | Previous screening | Demographic information | Explication of cut-off point of index test | Percentage missing | Missing data management | Subject selection for reference test |
|-------------------|----------------------|----------|--------------------|-------------------------|-------------------------------------------|-------------------|------------------------|----------------------------------|
| **Definition**    | Inclusion and exclusion criteria mentioned (F) | Enough information to identify setting (F) | No prescreening before application of the questionnaire (F) | Age, gender, BMI data provided (F) | Results presented for AHI \( \geq 5 \) or RDI \( \geq 15 \) (F) | Percentage missing mentioned (F) | Analysis of missing data for basic characteristics (F) | All subjects were invited or randomly selected to do PSG (F) |
| **General Population** | | | | | | | | |
| Silva[39] 2011    | F | F | F | F | F | F | U | F |
| Martí-Soler[40] 2016 | F | F | F | F | N | F | F | F |
| Tan[41] 2016     | F | F | N | F | F | F | P | F |
| Salías            | F | F | P | F | F | F | F | F |
| Peñafiel[42] 2019 | | | | | | | | |
| Bauters[43] 2020 | F | F | F | F | F | F | P | F |
| **Commercial Drivers and Pilots** | | | | | | | | |
| Firat[44] 2012   | F | F | F | P | F | F | N | F |
| Popević[45] 2017 | F | F | N | F | F | N/A | N/A | F |

F: Full meeting criteria; P: Partially meeting criteria; U: Unsure if meeting criteria in subgroups; not sure; N: Not meeting criteria in subgroups; N/A: Not applicable
Supplementary Table 4. Tables describing 2x2 contingency values and predictive parameters of individual studies for all OSA (AHI ≥ 5), moderate-to-severe OSA (AHI ≥ 15) and severe OSA (AHI ≥ 30) in the general population and commercial drivers

4A: Description of 2x2 contingency table

| STOP-Bang Positive (SB+) | Polysomnography Positive (PSG +) | Polysomnography Negative (PSG -) | Total |
|--------------------------|----------------------------------|----------------------------------|-------|
| True Positive            | False Positive                   | True Negative                    |       |
| STOP-Bang Negative (SB-) | False Negative                   | True Negative                    |       |
| Total                    |                                  |                                  |       |

4B: 2x2 contingency table for General Population – All OSA or AHI ≥ 5

| Author           | True Positive | False Positive | False Negative | True Negative | Sensitivity (95% Confidence Interval) | Specificity (95% Confidence Interval) |
|------------------|---------------|----------------|----------------|---------------|---------------------------------------|---------------------------------------|
| Marti-Soler2016  | 897           | 179            | 224            | 259           | 0.80 [0.78, 0.82]                     | 0.59 [0.54, 0.64]                     |
| Saldías Peñafiel2019 | 99     | 46             | 22             | 38            | 0.82 [0.74, 0.88]                     | 0.45 [0.34, 0.56]                     |
| Bauters2016      | 503           | 293            | 313            | 700           | 0.62 [0.58, 0.65]                     | 0.70 [0.68, 0.73]                     |

4C: 2x2 contingency table for General Population – Moderate-to-Severe OSA or AHI ≥ 15

| Author           | True Positive | False Positive | False Negative | True Negative | Sensitivity (95% Confidence Interval) | Specificity (95% Confidence Interval) |
|------------------|---------------|----------------|----------------|---------------|---------------------------------------|---------------------------------------|
| Silva2011        | 853           | 2600           | 95             | 1222          | 0.90 [0.88, 0.92]                     | 0.32 [0.30, 0.33]                     |
| Marti-Soler2016  | 501           | 575            | 50             | 434           | 0.91 [0.88, 0.93]                     | 0.43 [0.40, 0.46]                     |
| Tan2016          | 45            | 44             | 23             | 130           | 0.66 [0.54, 0.77]                     | 0.75 [0.68, 0.81]                     |
| Saldías Peñafiel2019 | 48    | 97             | 6              | 54            | 0.89 [0.77, 0.96]                     | 0.36 [0.28, 0.44]                     |
| Bauters2016      | 162           | 634            | 50             | 963           | 0.76 [0.70, 0.82]                     | 0.60 [0.58, 0.63]                     |

4D: 2x2 contingency table for General Population – Severe OSA or AHI ≥ 30

| Author           | True Positive | False Positive | False Negative | True Negative | Sensitivity (95% Confidence Interval) | Specificity (95% Confidence Interval) |
|------------------|---------------|----------------|----------------|---------------|---------------------------------------|---------------------------------------|
| Silva2011        | 319           | 3134           | 26             | 1294          | 0.92 [0.89, 0.95]                     | 0.29 [0.28, 0.31]                     |
| Marti-Soler2016  | 209           | 867            | 9              | 474           | 0.96 [0.92, 0.98]                     | 0.35 [0.33, 0.38]                     |
| Tan2016          | 18            | 71             | 8              | 145           | 0.69 [0.48, 0.86]                     | 0.67 [0.60, 0.73]                     |
| Bauters2016      | 56            | 740            | 11             | 1002          | 0.84 [0.73, 0.92]                     | 0.58 [0.55, 0.60]                     |

4E: 2x2 contingency table for Commercial Drivers– All OSA or AHI ≥ 5

| Author           | True Positive | False Positive | False Negative | True Negative | Sensitivity (95% Confidence Interval) | Specificity (95% Confidence Interval) |
|------------------|---------------|----------------|----------------|---------------|---------------------------------------|---------------------------------------|
| Popević2017      | 49            | 20             | 8              | 23            | 0.86 [0.74, 0.94]                     | 0.53 [0.38, 0.69]                     |

4F: 2x2 contingency table for Commercial Drivers– Moderate-to-Severe OSA or AHI ≥ 15

| Author           | True Positive | False Positive | False Negative | True Negative | Sensitivity (95% Confidence Interval) | Specificity (95% Confidence Interval) |
|------------------|---------------|----------------|----------------|---------------|---------------------------------------|---------------------------------------|
| Firat2012        | 40            | 20             | 6              | 19            | 0.87 [0.74, 0.95]                     | 0.49 [0.32, 0.65]                     |
| Popević2017      | 23            | 46             | 0              | 31            | 1.00 [0.85, 1.00]                     | 0.40 [0.29, 0.52]                     |

4G: 2x2 contingency table for Commercial Drivers– Severe OSA or AHI ≥ 30

| Author           | True Positive | False Positive | False Negative | True Negative | Sensitivity (95% Confidence Interval) | Specificity (95% Confidence Interval) |
|------------------|---------------|----------------|----------------|---------------|---------------------------------------|---------------------------------------|
| Popević2017      | 12            | 57             | 0              | 31            | 1.00 [0.74, 1.00]                     | 0.35 [0.25, 0.46]                     |