

**BTS Guideline for diagnosing and monitoring paediatric sleep disordered breathing****Online Appendix 4      Question 4 Evidence Review and Protocol**

**Q4      What is the diagnostic accuracy of pulse oximetry versus cardiorespiratory sleep studies for children with comorbid disorders predisposing to sleep disordered breathing?**

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## Question Evidence Review

### Q4 What is the diagnostic accuracy of pulse oximetry versus cardiorespiratory sleep studies for children with comorbid disorders predisposing to sleep disordered breathing?

#### Background

There are particular comorbid disorders seen in children that predispose to sleep disordered breathing (SDB). Children with comorbidities may have less obvious symptoms of SDB than typically developing children and therefore screening is often advocated. Current tests in the UK for diagnosing or detecting SDB in children are pulse oximetry, cardiorespiratory sleep study (CRSS) and polysomnography (PSG). When choosing which test to perform, considerations include which tests are accessible to the entire UK paediatric population, which tests are cost effective and which tests can accurately identify SDB. In the UK there is a desire to use simple investigations to detect SDB wherever possible, so this review evaluates the diagnostic accuracy of pulse oximetry and CRSS to diagnose SDB in children with comorbid disorders predisposing to SDB.

#### Outcomes

Diagnostic accuracy of pulse oximetry and CRSS to diagnose SDB in children with comorbid disorders predisposing to SDB

#### Evidence Review

The initial literature search identified 201 potentially relevant papers, but only six were deemed suitable for the review.<sup>1-6</sup> All studies that did not specifically address the review question or were not truly reflective of standard UK pulse oximetry or CRSS clinical practice were excluded from the review. All studies used PSG as a gold standard. Only a limited number of comorbid conditions were identified in these papers (Robin sequence<sup>1</sup>, Down Syndrome<sup>3</sup>, neuromuscular disease<sup>5</sup>, myelomeningocele<sup>4</sup> or varied disorders<sup>2</sup>), which is likely to be a source of bias and heterogeneity, and study groups included asymptomatic and symptomatic children. Due to the limited number of relevant studies, there was also heterogeneity in the pulse oximetry and CRSS parameters used across the studies ([Table 4a](#)).

Table 4a: Pulse oximetry and CRSS parameters

| Study                          | PSG cut-off | Oximetry/CRSS variable(s) measured/cut-off                              |
|--------------------------------|-------------|---|
| <i>Oximetry</i>                |             |   |
| Aaronson 2017 <sup>1</sup>     | AHI >10     | Minimum SpO <sub>2</sub> <80%   |
| Brouillette 2000* <sup>2</sup> | MOAHI >1    | ≥3 clusters of 3% SpO <sub>2</sub> dips to <90%                         |
| Lin 2014 <sup>3</sup>          | OAHI ≥1     | McGill score (cut-off not specified)                                    |
| Waters 1998* <sup>4</sup>      | AHI ≥5      | 'Moderate-to-severe' SDB from oximetry (exact definition not specified) |
| <i>CRSS</i>                    |             |   |
| Fishman 2018 <sup>5</sup>      | AHI >1      | AHI>1   |
|                                | AHI ≥5      | AHI ≥5  |
| Ikizoglu 2019 <sup>6</sup>     | AHI ≥1      | AHI ≥1  |

AHI – apnoea hypopnoea index; MOAHI – mixed/obstructive apnoea hypopnoea index; OAHI – obstructive apnoea hypopnoea index; SDB – sleep disordered breathing

\* Studies used a mix of PSG or CRSS as a gold standard, but were included in the meta-analyses because to the lack of supporting evidence

### Pulse Oximetry

Four studies investigated the diagnostic accuracy of pulse oximetry in the diagnosis of SDB in children with comorbid disorders. Meta-analysis of all available data, regardless of AHI cut-off, showed a sensitivity and specificity of 0.49 [0.31 to 0.67] and 0.87 [0.78 to 0.93] respectively [95% confidence intervals] ([Figure 4a](#)).<sup>1-4</sup>

#### Pulse Oximetry (AHI ≥1)

Sub-analysis of the diagnostic accuracy of pulse oximetry to diagnose an apnoea-hypopnea index (AHI) ≥1 in children with comorbid disorders gave a pooled estimate sensitivity of 0.43 [0.32 to 0.54] and specificity of 0.93 [0.84 to 0.98] [95% confidence intervals] ([Figure 4b](#)).<sup>2,3</sup>

### CRSS

Three analyses evaluated the diagnostic accuracy of CRSS for diagnosing SDB in children with comorbid disorders. Meta-analysis of the results showed a pooled sensitivity of 0.76 [0.47, 0.92] and pooled specificity of 0.62 [0.24, 0.89] [95% confidence intervals] ([Figure 4c](#)).<sup>5,6</sup>

#### CRSS (AHI ≥1)

Two studies specifically investigated the diagnostic accuracy of CRSS for diagnosing AHI ≥1, reporting a sensitivity and specificity of 0.85 [0.35, 0.98] and 0.41 [0.13, 0.76] respectively [95% confidence intervals] ([Figure 4d](#)).<sup>5,6</sup>

#### CRSS (AHI ≥5)

One study investigated the diagnostic accuracy of CRSS for diagnosing AHI ≥5, reporting a sensitivity and specificity of 0.62 [0.32, 0.86] and 0.87 [0.60, 0.98] respectively [95% confidence intervals].<sup>5</sup>

A summary of the pulse oximetry and CRSS results is shown in [Table 4b](#).

Table 4b: Diagnostic accuracies of pulse oximetry and cardiorespiratory sleep study for diagnosing sleep disordered breathing in children

| Included data                           | No. of datasets | Sensitivity [95% CI] | Specificity [95% CI] |
|---|-----------------|----------------------|----------------------|
| <a href="#">Pulse oximetry (all)</a>    | 4               | 0.49 [0.31, 0.67]    | 0.87 [0.78, 0.93]    |
| <a href="#">Pulse oximetry (AHI ≥1)</a> | 2               | 0.43 [0.32, 0.54]    | 0.93 [0.84, 0.98]    |
| <a href="#">CRSS (all)</a>              | 3               | 0.76 [0.47, 0.92]    | 0.62 [0.24, 0.89]    |
| <a href="#">CRSS (AHI ≥1)</a>           | 2               | 0.85 [0.35, 0.98]    | 0.41 [0.13, 0.76]    |
| CRSS (AHI ≥5) <sup>5</sup>              | 1               | 0.62 [0.32, 0.86]    | 0.87 [0.60, 0.98]    |

CI – confidence intervals; CRSS – cardiorespiratory sleep study

### Evidence statements

Pulse oximetry appears to have a low sensitivity and high specificity for diagnosing sleep disordered breathing in children with comorbid disorders ([Very Low](#))

Pulse oximetry appears to have a low sensitivity and very high specificity for diagnosing mild-to-moderate sleep disordered breathing in children with comorbid disorders ([Very Low](#))

Cardiorespiratory sleep studies appear to have a moderate sensitivity and low specificity for the diagnosis of sleep disordered breathing in children with neuromuscular disorders and Down Syndrome ([Very Low](#))

### Recommendation

- For children with neuromuscular disorders or Down Syndrome predisposing to sleep disordered breathing, cardiorespiratory sleep studies (CRSS) can be considered for diagnosing sleep disordered breathing ([Conditional](#))

**Good Practice Point**

- ✓ Although CRSS can only be recommended as a diagnostic tool for sleep disordered breathing in children with neuromuscular disorders or Down Syndrome, CRSS can be considered as a first line diagnostic tool for children with other comorbidities
- ✓ If a CRSS is abnormal, the significance of the findings should be carefully considered and the range of potential management options discussed with the child and their family/carer
- ✓ If CRSS findings are inconsistent with the clinical picture, the clinical history should be reviewed giving specific consideration to non-respiratory causes of sleep disorders. Referral to a neurology sleep service for assessment should also be considered
- ✓ If a CRSS is not available pulse oximetry can be considered as an initial diagnostic test for sleep disordered breathing in children with comorbid disorders, but if a test result is abnormal caution must be taken in interpreting the results as desaturations may have varying causes. Referral for more complex studies may be required to assess for hypoventilation and determine the cause and mechanisms of desaturation
- ✓ If a pulse oximetry test is normal this does not exclude sleep disordered breathing and clinical review should consider repeat/additional testing
- ✓ As desaturations are non-specific, if considering pulse oximetry for diagnosing sleep disordered breathing in children with comorbidities caution must be taken when interpreting the results
- ✓ If CRSS or pulse oximetry is inappropriate, or if a CRSS or pulse oximetry test result is inconsistent with the clinical picture, and non-respiratory causes of sleep disorders have been ruled out, then polysomnography (PSG) should be considered
- ✓ Clinicians are cautioned from using AHI alone to guide decision making
- ✓ If hypoventilation is suspected, guideline users should refer to Supplementary Online Appendix 3

**Research Recommendation**

- Research is needed into determining the diagnostic accuracy of pulse oximetry and cardiorespiratory sleep studies as a screening tool for diagnosing sleep disordered breathing in children with comorbid disorders, including cerebral palsy, Down Syndrome, neuromuscular disorders, craniofacial disorders and storage disorders

## Meta-analyses

### Diagnostic accuracy table contents and summary receiver operating characteristic (SROC) curve legend

#### Table contents

Pooled sensitivity [95% confidence intervals]

Pooled specificity [95% confidence intervals]

Likelihood ratio of a positive test result (LR+) [95% confidence intervals]

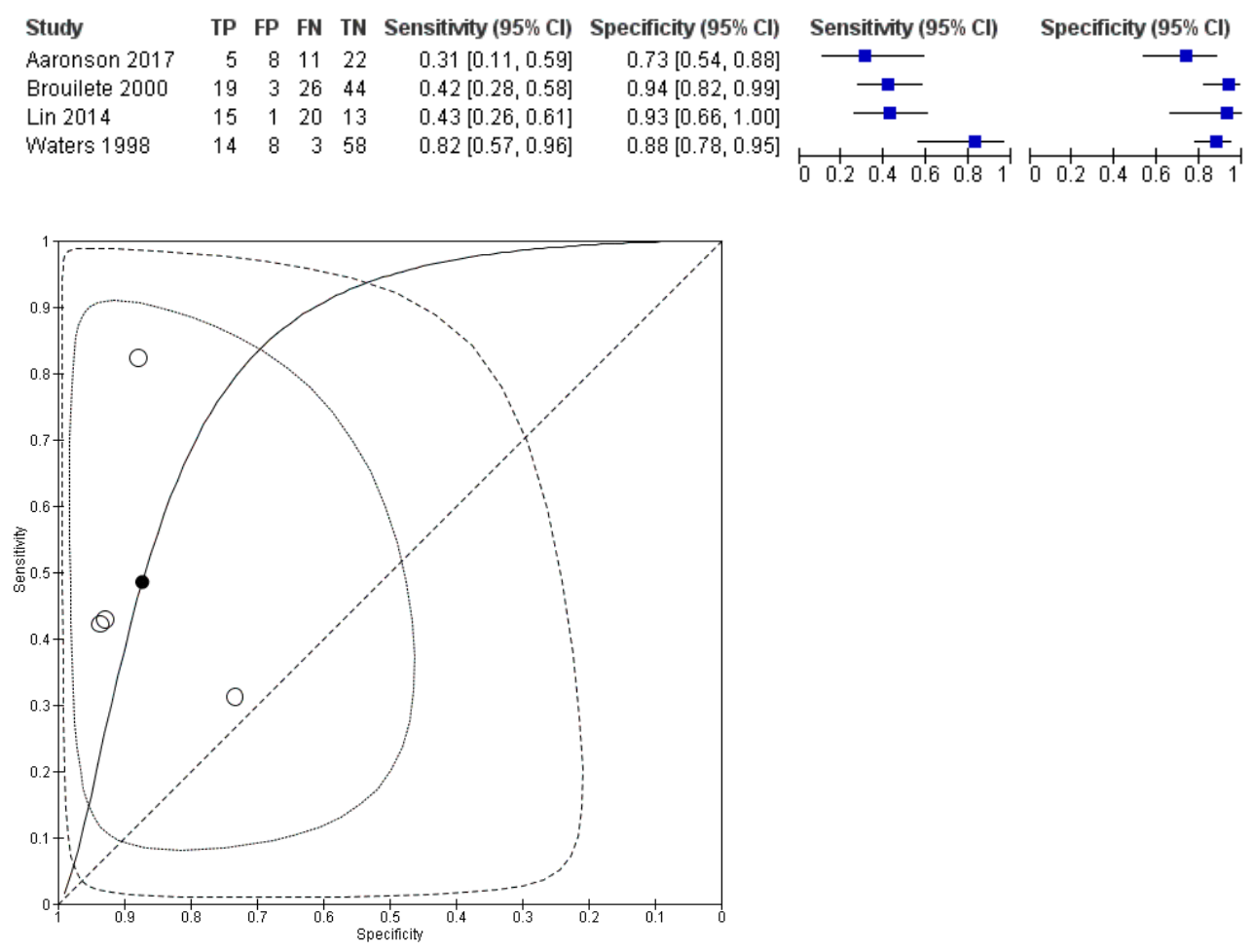
Likelihood ratio of a negative test result (LR-) [95% confidence intervals]

Diagnostic odds ratio (DOR, an indicator of the likelihood of a positive test result) [95% confidence intervals]

#### Summary receiver operating characteristic (SROC) curve legend

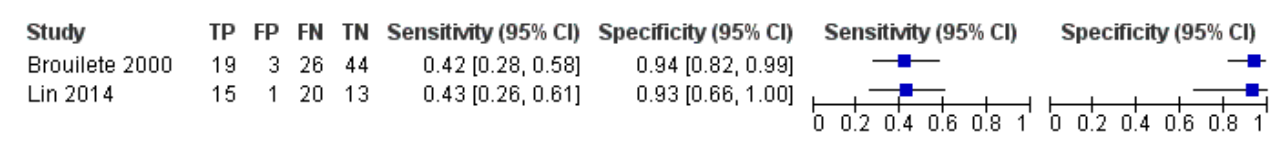
- SROC
- Study estimate
- Summary point
- ..... 95% confidence region
- 95% prediction region

**Figure 4a Pulse oximetry (all data)**



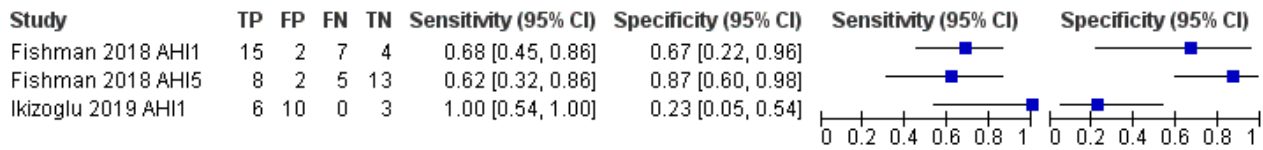
|                    |       |                  |
|--------------------|-------|------------------|
| Pooled Sensitivity | 0.485 | [0.308, 0.667]   |
| Pooled Specificity | 0.873 | [0.780, 0.930]   |
| LR+                | 3.816 | [0.911, 6.721]   |
| LR-                | 0.590 | [0.359, 0.821]   |
| DOR                | 6.472 | [-0.670, 13.614] |

**Figure 4b Pulse oximetry (AHI ≥1)**



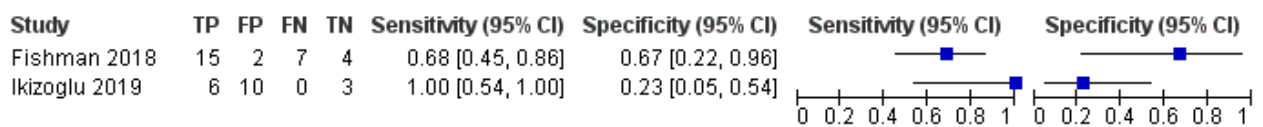
|                    |        |                  |
|--------------------|--------|------------------|
| Pooled Sensitivity | 0.425  | [0.322, 0.535]   |
| Pooled Specificity | 0.934  | [0.838, 0.975]   |
| LR+                | 6.481  | [0.123, 12.839]  |
| LR-                | 0.615  | [0.492, 0.738]   |
| DOR                | 10.533 | [-1.121, 22.187] |

**Figure 4c CRSS (all data)**



|                    |       |                 |
|--------------------|-------|-----------------|
| Pooled Sensitivity | 0.762 | [0.474, 0.919]  |
| Pooled Specificity | 0.616 | [0.242, 0.889]  |
| LR+                | 1.982 | [0.834, 4.713]  |
| LR-                | 0.386 | [0.170, 0.877]  |
| DOR                | 5.130 | [1.251, 21.037] |

**Figure 4d CRSS (AHI ≥1)**






|                    |       |                 |
|--------------------|-------|-----------------|
| Pooled Sensitivity | 0.848 | [0.353, 0.983]  |
| Pooled Specificity | 0.413 | [0.134, 0.762]  |
| LR+                | 1.444 | [0.801, 2.604]  |
| LR-                | 0.386 | [0.059, 2.286]  |
| DOR                | 3.921 | [0.419, 36.697] |



**Risk of bias summary**

|                  | <u>Risk of Bias</u> |            |                    |                 | <u>Applicability Concerns</u> |            |                    |
|------------------|---------------------|------------|--------------------|-----------------|-------------------------------|------------|--------------------|
|                  | Patient Selection   | Index Test | Reference Standard | Flow and Timing | Patient Selection             | Index Test | Reference Standard |
| Aaronson 2017    | +                   | ?          | ?                  | +               | +                             | ?          | +                  |
| Brouillette 2000 | +                   | +          | -                  | -               | +                             | +          | -                  |
| Fishman 2018     | +                   | +          | +                  | +               | +                             | +          | +                  |
| Ikizoglu 2019    | +                   | ?          | ?                  | +               | +                             | ?          | +                  |
| Lin 2014         | +                   | ?          | ?                  | +               | +                             | ?          | +                  |
| Waters 1998      | +                   | +          | -                  | -               | +                             | +          | -                  |

|   |  |  |
|---|--|--|
|  <b>High</b> |  <b>Unclear</b> |  <b>Low</b> |
|---|--|--|

## GRADE analyses

### Pulse oximetry (all data)

**What is the diagnostic accuracy of pulse oximetry versus cardiorespiratory sleep studies for children with comorbid disorders predisposing to sleep disordered breathing?**

**Patient or population:** Children (<17 years) with comorbid disorders predisposing to sleep disordered breathing

**New test:** Pulse oximetry

**Pooled sensitivity:** 0.48 (95% CI: 0.31 to 0.67) | **Pooled specificity:** 0.87 (95% CI: 0.78 to 0.93)

| Test result                                 | Number of results per 1,000 patients tested (95% CI)<br>Prevalence 40%*<br>Typically seen in | Number of participants (studies) | Certainty of the Evidence (GRADE) |
|---|--|----------------------------------|-----------------------------------|
| True positives                              | 194 (123 to 267)   | 113                              | ⊕○○○                              |
| False negatives                             | 206 (133 to 277)   | (4)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| True negatives                              | 524 (468 to 558)   | 157                              | ⊕○○○                              |
| False positives                             | 76 (42 to 132)   | (4)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| <b>Prevalence 60%*</b><br>Typically seen in |  |                                  |                                   |
| True positives                              | 291 (185 to 400)   | 113                              | ⊕○○○                              |
| False negatives                             | 309 (200 to 415)   | (4)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| True negatives                              | 349 (123 to 372)   | 157                              | ⊕○○○                              |
| False positives                             | 51 (28 to 88)  | (4)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| <b>Prevalence 80%*</b><br>Typically seen in |  |                                  |                                   |
| True positives                              | 388 (246 to 534)   | 113                              | ⊕○○○                              |
| False negatives                             | 412 (266 to 554)   | (4)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| True negatives                              | 175 (156 to 186)   | 157                              | ⊕○○○                              |
| False positives                             | 25 (14 to 44)  | (4)                              | <b>VERY LOW</b> <sup>a,b</sup>    |

CI: Confidence interval

#### Explanations

- a. High risk of bias across studies
- b. Sensitivity inconsistency in one study

\* 40% typically seen in district general hospitals; 60% typically seen in general respiratory clinics; 80% typically seen in sleep clinics

**Pulse oximetry (AHI ≥1)**

**What is the diagnostic accuracy of pulse oximetry versus cardiorespiratory sleep studies for children with comorbid disorders predisposing to sleep disordered breathing?**

**Patient or population:** Children (<17 years) with comorbid disorders predisposing to sleep disordered breathing

**New test:** Pulse oximetry (AHI ≥1)

**Pooled sensitivity:** 0.42 (95% CI: 0.32 to 0.54) | **Pooled specificity:** 0.95 (95% CI: 0.84 to 0.97)

| Test result                                 | Number of results per 1,000 patients tested (95% CI) | Number of participants (studies) | Certainty of the Evidence (GRADE) |
|---|--|----------------------------------|-----------------------------------|
| <b>Prevalence 40%*</b><br>Typically seen in |  |                                  |                                   |
| True positives                              | 170 (129 to 214)                                     | 80                               | ⊕○○○                              |
| False negatives                             | 230 (186 to 271)                                     | (2)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| True negatives                              | 560 (503 to 585)                                     | 61                               | ⊕○○○                              |
| False positives                             | 40 (15 to 97)  | (2)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| <b>Prevalence 60%*</b><br>Typically seen in |  |                                  |                                   |
| True positives                              | 255 (193 to 321)                                     | 80                               | ⊕○○○                              |
| False negatives                             | 345 (279 to 407)                                     | (2)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| True negatives                              | 374 (355 to 390)                                     | 61                               | ⊕○○○                              |
| False positives                             | 26 (10 to 65)  | (2)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| <b>Prevalence 80%*</b><br>Typically seen in |  |                                  |                                   |
| True positives                              | 340 (258 to 428)                                     | 80                               | ⊕○○○                              |
| False negatives                             | 460 (372 to 542)                                     | (2)                              | <b>VERY LOW</b> <sup>a,b</sup>    |
| True negatives                              | 187 (168 to 195)                                     | 61                               | ⊕○○○                              |
| False positives                             | 13 (5 to 32)   | (2)                              | <b>VERY LOW</b> <sup>a,b</sup>    |

CI: Confidence interval

**Explanations**

- a. High risk of bias across studies
- b. GRADE lowered by one score as result based on two studies

\* 40% typically seen in district general hospitals; 60% typically seen in general respiratory clinics; 80% typically seen in sleep clinics

**CRSS (all data)**

**What is the diagnostic accuracy of pulse oximetry versus cardiorespiratory sleep studies for children with comorbid disorders predisposing to sleep disordered breathing?**

**Patient or population:** Children (<17 years) with comorbid disorders predisposing to sleep disordered breathing

**New test:** CRSS

**Pooled sensitivity:** 0.76 (95% CI: 0.47 to 0.92) | **Pooled specificity:** 0.62 (95% CI: 0.24 to 0.89)

| Test result                                 | Number of results per 1,000 patients tested (95% CI) | Number of participants (studies) | Certainty of the Evidence (GRADE) |
|---|--|----------------------------------|-----------------------------------|
| <b>Prevalence 40%*</b><br>Typically seen in |  |                                  |                                   |
| <b>True positives</b>                       | <b>305</b> (190 to 368)                              | 41                               | ⊕○○○                              |
| <b>False negatives</b>                      | <b>95</b> (32 to 210)                                | (3)                              | <b>VERY LOW</b> <sup>a,b,c</sup>  |
| <b>True negatives</b>                       | <b>370</b> (145 to 533)                              | 34                               | ⊕○○○                              |
| <b>False positives</b>                      | <b>230</b> (67 to 455)                               | (3)                              | <b>VERY LOW</b> <sup>a,b,c</sup>  |
| <b>Prevalence 60%*</b><br>Typically seen in |  |                                  |                                   |
| <b>True positives</b>                       | <b>457</b> (284 to 551)                              | 41                               | ⊕○○○                              |
| <b>False negatives</b>                      | <b>143</b> (49 to 316)                               | (3)                              | <b>VERY LOW</b> <sup>a,b,c</sup>  |
| <b>True negatives</b>                       | <b>246</b> (97 to 356)                               | 34                               | ⊕○○○                              |
| <b>False positives</b>                      | <b>154</b> (44 to 303)                               | (3)                              | <b>VERY LOW</b> <sup>a,b,c</sup>  |
| <b>Prevalence 80%*</b><br>Typically seen in |  |                                  |                                   |
| <b>True positives</b>                       | <b>610</b> (379 to 735)                              | 41                               | ⊕○○○                              |
| <b>False negatives</b>                      | <b>190</b> (65 to 421)                               | (3)                              | <b>VERY LOW</b> <sup>a,b,c</sup>  |
| <b>True negatives</b>                       | <b>123</b> (48 to 178)                               | 34                               | ⊕○○○                              |
| <b>False positives</b>                      | <b>77</b> (22 to 152)                                | (3)                              | <b>VERY LOW</b> <sup>a,b,c</sup>  |

CI: Confidence interval

**Explanations**

- a. Some risk of bias across studies
- b. Serious inconsistency across the studies
- c. Moderate confidence intervals in some datasets

\* 40% typically seen in district general hospitals; 60% typically seen in general respiratory clinics; 80% typically seen in sleep clinics

**CRSS (AHI ≥1)**

**What is the diagnostic accuracy of pulse oximetry versus cardiorespiratory sleep studies for children with comorbid disorders predisposing to sleep disordered breathing?**

**Patient or population:** Children (<17 years) with comorbid disorders predisposing to sleep disordered breathing

**New test:** CRSS (AHI ≥1)

**Pooled sensitivity:** 0.85 (95% CI: 0.35 to 0.98) | **Pooled specificity:** 0.41 (95% CI: 0.13 to 0.76)

| Test result                                 | Number of results per 1,000 patients tested (95% CI) | Number of participants (studies) | Certainty of the Evidence (GRADE)  |
|---|--|----------------------------------|------------------------------------|
| <b>Prevalence 40%*</b><br>Typically seen in |  |                                  |                                    |
| <b>True positives</b>                       | <b>339</b> (141 to 393)                              | 222                              | ⊕○○○                               |
| <b>False negatives</b>                      | <b>61</b> (7 to 259)                                 | (9)                              | <b>VERY LOW</b> <sup>a,b,c,d</sup> |
| <b>True negatives</b>                       | <b>248</b> (80 to 457)                               | 667                              | ⊕○○○                               |
| <b>False positives</b>                      | <b>352</b> (143 to 520)                              | (9)                              | <b>VERY LOW</b> <sup>a,b,c,d</sup> |
| <b>Prevalence 60%*</b><br>Typically seen in |  |                                  |                                    |
| <b>True positives</b>                       | <b>509</b> (212 to 590)                              | 222                              | ⊕○○○                               |
| <b>False negatives</b>                      | <b>91</b> (10 to 388)                                | (9)                              | <b>VERY LOW</b> <sup>a,b,c,d</sup> |
| <b>True negatives</b>                       | <b>165</b> (54 to 305)                               | 667                              | ⊕○○○                               |
| <b>False positives</b>                      | <b>235</b> (95 to 346)                               | (9)                              | <b>VERY LOW</b> <sup>a,b,c,d</sup> |
| <b>Prevalence 80%*</b><br>Typically seen in |  |                                  |                                    |
| <b>True positives</b>                       | <b>678</b> (282 to 786)                              | 222                              | ⊕○○○                               |
| <b>False negatives</b>                      | <b>122</b> (14 to 518)                               | (9)                              | <b>VERY LOW</b> <sup>a,b,c,d</sup> |
| <b>True negatives</b>                       | <b>83</b> (27 to 152)                                | 667                              | ⊕○○○                               |
| <b>False positives</b>                      | <b>117</b> (48 to 173)                               | (9)                              | <b>VERY LOW</b> <sup>a,b,c,d</sup> |

CI: Confidence interval

**Explanations**

- Some risk of bias across studies
- Some indirectness – 2 different disease conditions
- Inconsistency across the studies
- Moderate confidence intervals

\* 40% typically seen in district general hospitals; 60% typically seen in general respiratory clinics; 80% typically seen in sleep clinics

## Recommendation Tables

### Question Details

|                       |   |
|-----------------------|---|
| <b>POPULATION:</b>    | Children (<17 years) with suspected sleep disordered breathing and comorbid disorder(s)                               |
| <b>INDEX TESTS:</b>   | Pulse oximetry and cardiorespiratory sleep study (CRSS)   |
| <b>GOLD STANDARD:</b> | Polysomnography (PSG)   |
| <b>OUTCOME:</b>       | Diagnostic accuracy of CRSS for diagnosing sleep disordered breathing in infants and children with comorbid disorders |

### Pulse oximetry

#### SUMMARY OF JUDGEMENTS

| PROBLEM               | JUDGEMENT              |                                 |  |                                   |                          |        |                     |
|-----------------------|------------------------|---------------------------------|--|-----------------------------------|--------------------------|--------|---------------------|
|                       | No                     | Probably no                     | Probably yes                                       | Yes                               |                          | Varies | Don't know          |
| TEST ACCURACY         | Very inaccurate        | Inaccurate                      | Accurate   | Very accurate                     |                          | Varies | Don't know          |
| DESIRABLE EFFECTS     | Trivial                | Small                           | Moderate   | Large                             |                          | Varies | Don't know          |
| UNDESIRABLE EFFECTS   | Large                  | Moderate                        | Small  | Trivial                           |                          | Varies | Don't know          |
| CERTAINTY OF EVIDENCE | Very low               | Low                             | Moderate   | High                              |                          |        | No included studies |
| BALANCE OF EFFECTS    | Favours the comparison | Probably favours the comparison | Does not favour the intervention or the comparison | Probably favours the intervention | Favours the intervention | Varies | Don't know          |

#### TYPE OF RECOMMENDATION

|  |  |  |   |  |
|--|--|--|---|--|
| Strong recommendation against the intervention | <b>Conditional recommendation against the intervention</b> | Conditional recommendation for either the intervention or the comparison | Conditional recommendation for the intervention | Strong recommendation for the intervention |
| <input type="checkbox"/>                       | <input checked="" type="checkbox"/>                        | <input type="checkbox"/>   | <input type="checkbox"/>                        | <input type="checkbox"/>                   |

**CONCLUSIONS****Recommendation**

Currently pulse oximetry should not be used for diagnosing sleep disordered breathing in children with comorbid disorders

**Justification**

Pulse oximetry has a low sensitivity and high specificity for diagnosing sleep disordered breathing in children with comorbid disorders ([Very Low](#))

**Subgroup considerations**

There were not enough data to consider children with cerebral palsy, Down Syndrome, craniofacial disorders, or storage disorders

**Research priorities**

Research is needed into determining the diagnostic accuracy of pulse oximetry as a screening tool for diagnosing sleep disordered breathing in children with comorbid disorders, including cerebral palsy, Down Syndrome, neuromuscular disorders, craniofacial disorders and storage disorders

**CRSS****SUMMARY OF JUDGEMENTS**

|                       | JUDGEMENT              |                                 |  |  |                          |        |                     |
|-----------------------|------------------------|---------------------------------|--|--|--------------------------|--------|---------------------|
| PROBLEM               | No                     | Probably no                     | Probably yes                                       | <b>Yes</b>                               |                          | Varies | Don't know          |
| TEST ACCURACY         | Very inaccurate        | Inaccurate                      | <b>Accurate</b>                                    | Very accurate                            |                          | Varies | Don't know          |
| DESIRABLE EFFECTS     | Trivial                | Small                           | Moderate   | <b>Large</b>                             |                          | Varies | Don't know          |
| UNDESIRABLE EFFECTS   | Large                  | Moderate                        | <b>Small</b>                                       | Trivial                                  |                          | Varies | Don't know          |
| CERTAINTY OF EVIDENCE | Very low               | Low                             | <b>Moderate</b>                                    | High                                     |                          |        | No included studies |
| BALANCE OF EFFECTS    | Favours the comparison | Probably favours the comparison | Does not favour the intervention or the comparison | <b>Probably favours the intervention</b> | Favours the intervention | Varies | Don't know          |

**TYPE OF RECOMMENDATION**

| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | <b>Conditional recommendation for the intervention</b> | Strong recommendation for the intervention |
|--|---|--|--|--|
| <input type="checkbox"/>                       | <input type="checkbox"/>                            | <input type="checkbox"/>   | <input checked="" type="checkbox"/>                    | <input type="checkbox"/>                   |

**CONCLUSIONS****Recommendation**

For children with neuromuscular disorders predisposing to sleep disordered breathing, cardiorespiratory sleep studies can be considered for diagnosing sleep disordered breathing

**Justification**

Cardiorespiratory sleep studies have a moderate sensitivity and low specificity for the diagnosis of sleep disordered breathing in children with neuromuscular disorders and Down Syndrome ([Very Low](#))

**Subgroup considerations**

There were not enough data to consider children with cerebral palsy, Down Syndrome, craniofacial disorders, or storage disorders

**Research priorities**

Research is needed into determining the diagnostic accuracy of cardiorespiratory sleep studies as a screening tool for diagnosing sleep disordered breathing in children with comorbid disorders, including cerebral palsy, Down Syndrome, neuromuscular disorders, craniofacial disorders and storage disorders



## References

1. Aaronson NL, Jabbour N. Can telemetry data obviate the need for sleep studies in Pierre Robin Sequence? *International Journal of Pediatric Otorhinolaryngology*. 2017;100:238-241.
2. Brouillette RT, Morielli A, Leimanis A, Waters KA, Luciano R, Ducharme FM. Nocturnal pulse oximetry as an abbreviated testing modality for pediatric obstructive sleep apnea. *Pediatrics*. 2000;105:405-412.
3. Lin SC, Davey MJ, Horne RS, Nixon GM. Screening for obstructive sleep apnea in children with Down syndrome. *Journal of Pediatrics*. 2014;165:117-122.
4. Waters KA, Forbes P, Morielli A, et al. Sleep-disordered breathing in children with myelomeningocele. *Journal of Pediatrics*. 1998;132:672-681.
5. Fishman H, Massicotte C, Li R, et al. The accuracy of an ambulatory level III sleep study compared to a level I sleep study for the diagnosis of sleep-disordered breathing in children with neuromuscular disease. *Journal of Clinical Sleep Medicine*. 2018;14:2013-2020.
6. Ikizoglu NB, Kiyani E, Polat B, Ay P, Karadag B, Ersu R. Are home sleep studies useful in diagnosing obstructive sleep apnea in children with down syndrome? *Pediatric Pulmonology*. 2019;54:1541-1546.

## Question Protocol

| Field  | Content  |
|--|--|
| Review Question  | For asymptomatic children with comorbid disorders and predisposing to sleep disordered breathing, what is the diagnostic accuracy of pulse oximetry and cardiorespiratory sleep studies?   |
| Type of review question  | Diagnostic accuracy  |
| Objective of the review  | <p>Certain groups of children (e.g. those with neuro-disability) may have less obvious symptoms of sleep disordered breathing than typically developing children and therefore screening is advocated. It is uncertain what test modality is most appropriate. Oximetry is much simpler and less obtrusive than cardiorespiratory sleep studies and can be done at home. This may be particularly important for this group of children.</p> <ul style="list-style-type: none"> <li>• Does normal oximetry rule out significant SDB?</li> <li>• How sensitive and specific is oximetry?</li> <li>• Is there a difference between home and hospital oximetry?</li> </ul> |
| Eligibility criteria – population / disease / condition / issue / domain | Children (<17 years) with comorbid disorders predisposing to sleep disordered breathing  |
| Eligibility criteria – index test(s)                                     | Pulse oximetry<br>Cardiorespiratory sleep studies  |
| Eligibility criteria – gold standard                                     | Polysomnography  |
| Outcomes and prioritisation  | Diagnostic accuracy  |
| Eligibility criteria – study design                                      | Randomised controlled trials<br>Observational studies<br>Superiority studies<br>Case series  |
| Other inclusion /exclusion criteria                                      | <p>Non-English language excluded unless full English translation</p> <p>Conference abstracts, Cochrane reviews, systematic reviews, reviews</p> <p>Cochrane reviews and systematic reviews can be referenced in the text, but <b>DO NOT</b> use in a meta-analysis</p>   |

|   |  |          |   |         |                    |          |  |
|---|--|----------|---|---------|--------------------|----------|--|
| Proposed sensitivity / subgroup analysis, or meta-regression                        | <p>Children &lt;2 years with cerebral palsy</p> <p>Children 2-16 years with cerebral palsy</p> <p>Children &lt;2 years with Down Syndrome</p> <p>Children 2-16 years with Down Syndrome</p> <p>Children &lt;2 years with craniofacial disorders</p> <p>Children 2-16 years with craniofacial disorders</p> <p>Children &lt;2 years with storage disorders</p> <p>Children 2-16 years with storage disorders</p>  |          |   |         |                    |          |  |
| Selection process – duplicate screening / selection / analysis                      | <p>Agreement should be reached between Guideline members who are working on the question. If no agreement can be reached, a decision should be made by the Guideline co-chairs. If there is still no decision, the matter should be brought to the Guideline group and a decision will be made by consensus</p>  |          |   |         |                    |          |  |
| Data management (software)  | <table border="0"> <tr> <td data-bbox="547 869 710 992">RevMan5</td> <td data-bbox="718 869 1452 992">Meta-analysis data input.<br/>Evidence review/considered judgement.<br/>Storing Guideline text, tables, figures, etc.</td> </tr> <tr> <td data-bbox="547 1003 710 1037">MetaDTA</td> <td data-bbox="718 1003 1452 1037">Data meta-analyses</td> </tr> <tr> <td data-bbox="547 1048 710 1081">Gradepro</td> <td data-bbox="718 1048 1452 1081">Quality of evidence assessment / Recommendations</td> </tr> </table> | RevMan5  | Meta-analysis data input.<br>Evidence review/considered judgement.<br>Storing Guideline text, tables, figures, etc. | MetaDTA | Data meta-analyses | Gradepro | Quality of evidence assessment / Recommendations |
| RevMan5   | Meta-analysis data input.<br>Evidence review/considered judgement.<br>Storing Guideline text, tables, figures, etc.  |          |   |         |                    |          |  |
| MetaDTA   | Data meta-analyses   |          |   |         |                    |          |  |
| Gradepro  | Quality of evidence assessment / Recommendations   |          |   |         |                    |          |  |
| Information sources – databases and dates   | <p>MEDLINE, Embase, PubMed, Central Register of Controlled Trials and Cochrane Database of Systematic Reviews</p> <p>No date restriction</p>   |          |   |         |                    |          |  |
| Methods for assessing bias at outcome / study level                                 | <p>RevMan5 diagnostic accuracy full review template (based on QUADAS2) (follow instructions in '<i>BTS Guideline Process Handbook - Diagnostic Accuracy</i>')</p>  |          |   |         |                    |          |  |
| Methods for quantitative analysis – combining studies and exploring (in)consistency | <p>If 3 or more relevant studies:</p> <p>RevMan5 for forest plots, summary ROC plot</p> <p>MetaDTA to combine studies (pooled specificity, sensitivity, likelihood ratios, diagnostic odds ratio and confidence intervals) and calculate RevMan parameters for summary ROC plot</p> <p>(follow instructions in '<i>BTS Guideline Process Handbook - Diagnostic Accuracy</i>')</p>  |          |   |         |                    |          |  |
| Meta-bias assessment – publication bias, selective reporting bias                   | <table border="0"> <tr> <td data-bbox="547 1854 710 1933">GRADEpro</td> <td data-bbox="718 1854 1452 1933">Diagnostic accuracy quality of evidence assessment for each index test</td> </tr> </table> <p>(follow instructions in '<i>BTS Guideline Process Handbook - Diagnostic Accuracy</i>')</p>  | GRADEpro | Diagnostic accuracy quality of evidence assessment for each index test  |         |                    |          |  |
| GRADEpro  | Diagnostic accuracy quality of evidence assessment for each index test   |          |   |         |                    |          |  |

|                                     |  |
|-------------------------------------|--|
| Rationale / context – what is known | There is very little known about simpler testing modalities such as oximetry in high-risk children. The literature contains some cross-sectional studies in those with Down Syndrome and craniofacial disorders. |
|-------------------------------------|--|