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Original research

Nasal versus oronasal masks for home non-invasive ventilation in patients with chronic hypercapnia: a systematic review and individual participant data meta-analysis

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ABSTRACT

Background The optimal interface for the delivery of home non-invasive ventilation (NIV) to treat chronic respiratory failure has not yet been determined. The aim of this individual participant data (IPD) meta-analysis was to compare the effect of nasal and oronasal masks on treatment efficacy and adherence in patients with COPD and obesity hypoventilation syndrome (OHS).

Methods We searched Medline and Cochrane Central Register of Controlled Trials for prospective randomised controlled trials (RCTs) of at least 1 month's duration, published between January 1994 and April 2019, that assessed NIV efficacy in patients with OHS and COPD. The main outcomes were diurnal PaCO₂, PaO₂ and NIV adherence (PROSPERO CRD42019132398).

Findings Of 1576 articles identified, 34 RCTs met the inclusion criteria and IPD were obtained for 18. Ten RCTs were excluded because only one type of mask was used, or mask data were missing. Data from 8 RCTs, including 290 IPD, underwent meta-analysis. Oronasal masks were used in 86% of cases. There were no differences between oronasal and nasal masks for PaCO₂ (0.61 mm Hg (95% CI -2.15 to 3.38); p=0.68), PaO₂ (-0.00 mm Hg (95% CI -4.59 to 4.58); p=1) or NIV adherence (0.29 hour/day (95% CI -0.74 to 1.32); p=0.58). There was no interaction between the underlying pathology and the effect of mask type on any outcome.

Interpretation Oronasal masks are the most used interface for the delivery of home NIV in patients with OHS and COPD; however, there is no difference in the efficacy or tolerance of oronasal or nasal masks.

INTRODUCTION

Non-invasive positive-pressure ventilation (NIV) is the first choice of long-term, home treatment for chronic hypercapnic respiratory failure.¹ The use of NIV has vastly increased over the last 20 years in most countries worldwide, in particular for the treatment of COPD and obesity hypoventilation syndrome (OHS).² Research has shown that NIV

Key messages

What is the key question?

► What are the effects of nasal and oronasal masks on non-invasive ventilation (NIV) efficacy and adherence to treatment in patients with COPD and patients with obesity hypoventilation syndrome (OHS)?

What is the bottom line?

► This work demonstrated that oronasal masks were used in the majority of cases (86%) for home NIV in patients with COPD and patients with OHS. There was no statistical difference between the two types of interface in terms of PaCO₂, PaO₂ or adherence. Also, there were no interactions between the underlying pathology and the effect of the mask type on the primary or any of the secondary outcomes.

Why read on?

► This systematic review and meta-analysis on individual participant data is the product of a large international collaboration that included individual data from 18 RCTs with a total of nearly 300 patients finally analysed. Our results allow to rule out a question that all clinicians ask themselves when it comes to choosing the most appropriate interface for a patient.

improves both physiological and clinical outcomes in both these diseases.³⁻⁸

The choice of interface through which to deliver home NIV is crucial: the mask must allow efficient ventilation while being sufficiently comfortable for the patient to adhere well to the treatment. Two types of interfaces are available: nasal masks and oronasal masks. Nasal masks are unobtrusive and easy to fit but persistent mouth leaks can reduce NIV efficacy, impair sleep quality⁹ and cause side effects such as nasal congestion and mouth dryness.¹⁰ The



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interface choice is based on the results of a clinical assessment during which the patient's preference and tolerance are determined. The choice can also be influenced by whether NIV is initiated during an acute exacerbation or a stable phase of the condition. Oronasal masks are usually used in the management of acute exacerbations, and the patient then keeps this interface for home NIV, whereas in the stable phase, a wider range of interfaces may be used at initiation.¹¹ However, the proportion of nasal/oronasal masks used for long-term NIV is not well documented and because of the lack of clear evidence of a particular strategy, the choice of interface is mainly driven by patients' preferences, team expertise and habits.^{2 12}

Appropriately designed studies investigating the impact of interface type in the field of long-term NIV for chronic respiratory failure are lacking. Low-quality studies (small sample sizes and/or non-randomised designs)^{13 14} are in favour of the use of nasal masks: Wilson *et al*¹³ found a trend towards a lower mean peripheral capillary oxygen saturation (SpO₂) and poorer sleep quality with the use of oronasal masks, although they found that mouth leaks with nasal masks required almost systematic use of a chin strap. Fernandez *et al*¹⁴ showed that patients preferred nasal masks to oronasal masks as they were more comfortable. However, a recent randomised, crossover study failed to highlight the superiority of one type of interface in terms of efficacy or tolerance in patients with neuromuscular diseases.¹⁵ In addition, all studies were performed in non-naïve patients, preventing definitive conclusions regarding optimal mask selection in chronic respiratory failure.¹⁶

The effect of nasal and oronasal masks on both physiological^{17–19} and clinical variables^{20–26} has been more robustly evaluated in patients with obstructive sleep apnoea (OSA) treated with CPAP. In this pathology, oronasal masks have been associated with higher pressure requirements, an increase in the residual Apnea-Hypnoea Index and poorer adherence compared with nasal masks.²⁶ However, studies that take into account the different requirements of the underlying diseases (COPD, OHS, restrictive disorders, etc) are required to confirm these results.

There is thus a lack of available evidence to guide the choice of interface for NIV delivery in patients with COPD and OHS. In view of the importance of this issue, we conducted an individual participant data (IPD) meta-analysis of randomised controlled trials (RCT) to compare the effects of nasal and oronasal masks on NIV efficacy and adherence to treatment in patients with COPD and OHS. We chose these two distinct conditions because they currently represent the most common indications for home NIV treatment. The reason we decided to conduct an IPD meta-analysis was twofold: first, there is a lack of studies specifically comparing nasal and oronasal masks, and second the data reported in currently available trials are not appropriate for aggregation. Our overall aim was to provide objective data to guide clinicians in the choice of the most appropriate interface for long-term home NIV delivery in these patient groups.

METHODS

This systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses of Individual Patient Data statements.²⁷ The study protocol was developed in collaboration with clinical and research experts in the field and was registered in the International Prospective Register of Systematic Reviews (PROSPERO # CRD42019132398). It is available online.

Search strategy and selection criteria

Two investigators (ML and AL) searched Medline and the Cochrane Central Register of Controlled Trials from 1 January 1994 to 1 April 2019. The 1994 limit was chosen because the first studies of oronasal masks for the delivery of positive pressure therapy were published that year.^{28 29} Search terms were chosen to detect RCTs of NIV in individuals with OHS and COPD. Further details of the search strategy can be found in the online supplemental page 1. The searches were supplemented by review of the reference lists of the publications, previous meta-analyses and guidelines found. The search was not restricted to articles written in English.

Trial inclusion criteria

Inclusion criteria were applied at the study level and were defined a priori. The following inclusion criteria were used: (1) prospective and original RCTs in adult patients with COPD and/or OHS on long-term Home NIV, (2) trial duration of at least 1 month and (3) the assessment of NIV efficacy included diurnal PaCO₂ measured in arterial blood gas samples, or a surrogate measure such as transcutaneous CO₂ pressure (tcCO₂).

Study and data selection process

Two authors (M.L. and A.L.) reviewed the titles and abstracts of trials identified by the searches using www.covidence.org. Selected full-text articles were then reviewed for eligibility by the same authors. Any disagreement was settled by discussion. If consensus could not be reached, a third reviewer (J.C.B) resolved the disagreement. The authors of each trial included were personally contacted by email and asked if they would accept to share participant data. If they agreed, they were asked to complete a standardised datasheet. The following data were requested: anthropometric descriptions, FEV₁, FVC, baseline arterial blood gases (PaCO₂ - PaO₂), NIV settings, type of mask used (ie, nasal or oronasal), PaCO₂, PaO₂ and adherence at study endpoint. Since the purpose of the meta-analysis was to determine the effect of mask-type on NIV efficacy and adherence, data were only requested for subjects included in the NIV groups of the trials. No aggregate data were sought.

The risk of bias of the studies included in the meta-analysis was evaluated using the revised Cochrane collaboration risk-of-bias tool for RCTs.³⁰ Finally, as suggested by a reviewer we applied the Grading of Recommendation Assessment, Development and Evaluation (GRADE) criteria to appraise the overall quality of the findings.³¹

Outcomes

The primary outcome was diurnal PaCO₂ (or surrogate PtcCO₂) at the endpoint of each study. Secondary outcomes were diurnal PaO₂, NIV adherence (extracted from NIV built-in software in hours/night) and level of inspiratory positive airway pressure (IPAP)/expiratory positive airway pressure (EPAP). All outcomes were pre-specified except for diurnal PaO₂, which was added during the data selection process.

Data synthesis and analysis

All analyses were conducted according to the predefined statistical analysis plan outlined in the protocol (CRD42016037482). PaCO₂ and PaO₂ were analysed using a generalised linear mixed model with a fixed effect (type of mask nasal or oronasal) and a random effect (slope and intercept) for trial. All analyses were adjusted for the prespecified baseline covariates: age, sex, body mass index (BMI), study type (crossover vs parallel), baseline

PaCO₂ or PaO₂, FEV₁, adherence and study duration. Adherence, IPAP and EPAP were analysed using the fully adjusted model. For crossover studies, only data from the first randomised period were analysed. As suggested by a reviewer, we performed a trial sequential analysis to estimate the optimal sample size needed to highlight a mean difference of 3 mm Hg³² (non-inferiority margins) for the primary outcome (PaCO₂) with an alpha type 1 error of 5%, power of 80%, and the variance and heterogeneity estimated from the meta-analysis. We calculated O'brian and Flemming adjusted boundaries for statistical significance and futility. This analysis is provided in the online supplemental page 1817.

The number of missing data was minimal in the eight trials selected for meta-analysis; thus, we were able to perform a complete case analysis. All between-group differences are presented as point estimates with 95% CIs and p values. The null hypothesis was that there was no between-group difference in the means. The marginal means of the adjusted models are presented. For all analyses, statistical significance was inferred when the two-sided p value was <0.05. We also tested the hypothesis that nasal masks were non-inferior to oronasal masks, although the analysis was not specifically designed to test this. This secondary analysis and its methods are provided in the online supplemental page 15.

To assess the consistency of the results and to allow for visual inspection of between-study and within-study variability, a two-stage meta-analysis was also performed.³³ The adjusted between-mask mean difference between each trial (adjusted for age, sex, FEV₁, adherence, BMI and baseline PaCO₂ - PaO₂) was calculated. Then, the results from each individual trial were combined using fixed or random (Dersimonian and Laird) effect methods according to heterogeneity, with a I² cut-off at 50%.

Post hoc analysis was used to test interactions between mask-type and the underlying pathology (COPD and OHS) and interactions between mask-type and duration of follow-up in all fully adjusted models. To further explore the potential differences in mask efficacy between COPD and OHS, we performed two separate analyses according to the underlying pathology.

All analyses were performed with Jamovi (Gamjl package) and R packages lmer4, lmerTest and meta.

RESULTS

Study selection and collection of IPD

The literature search yielded 1576 articles, of which 58 full texts were reviewed and 34 RCTs met the inclusion criteria (figure 1). The authors of 18 of the RCTs accepted to share IPD.^{7 32 34-49}

On receipt of IPD, we found that nine studies had only used one type of mask^{7 33 38 40 42 44-47} and in one study, data relating to the type of mask used were unavailable³⁹; therefore, we excluded these studies from the meta-analysis. Thus, the meta-analysis was carried out on data from 8 RCTs, including 290 patients for whom mask-type data were available (data were unavailable for 10 patients).^{32 34 35 37 38 41 43 45}

Study characteristics

Table 1 reports the main characteristics of studies included in the meta-analysis. Four trials included patients with OHS,^{34 35 43 45} three trials included patients with COPD^{32 37 38} and one trial included both patients with COPD and OHS.⁴¹ Sample sizes ranged from 14³⁸ to 221.³⁴ The studies by Duiverman *et al*³⁸ and Kelly *et al*⁴¹ were crossover trials.

The studies by Masa *et al*^{34 43} compared NIV to CPAP or lifestyle modifications in OHS, and the study by Borel *et al*³⁵ only

compared NIV to lifestyle modifications. Three RCTs compared NIV modes or settings.^{38 41 45} Finally, one study compared NIV initiation at home versus hospital³² and another assessed the efficacy of nocturnal NIV plus a rehabilitation programme.³⁷ Data for all primary and secondary outcomes were available for each study, except for the study by Kelly *et al*⁴¹ for which data from PaCO₂ and PaO₂ were not available at the study endpoint; instead, mean overnight PtcCO₂ and SpO₂ were provided. For that study, only mean overnight PtcCO₂ was considered in the meta-analysis. All baseline variables that were planned to be used for adjustment were available.

The baseline characteristics of participants according to mask type are shown in table 2. Detailed baseline characteristics at the IPD level are provided for each study in the online supplement (online supplemental e-table 1).

Risk of bias, IPD integrity and GRADE criteria

The overall risk of bias in the RCTs ranged from low to high; details of the analysis are provided in the online supplement (online supplemental e-figure 1). The IPD provided by the authors were in accordance with published aggregate data. The GRADE criteria rating showed that the overall quality of the findings was very low (online supplemental e-table 2).

Prevalence of use of oronasal and nasal masks

In the 18 RCTs^{7 32 34-49} for which IPD were provided (n=632), 88% of participants used an oronasal mask (n=471); data

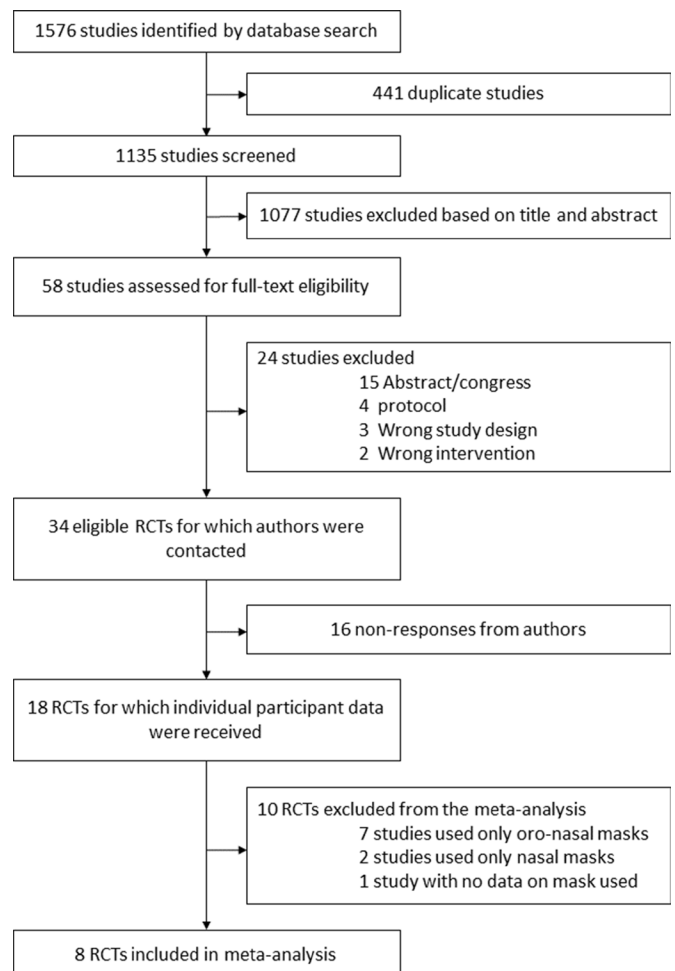


Figure 1 Study selection. RCTs, randomised controlled trials.

Table 1 Characteristics of the included studies

Study	Location	Design	Population	Sample size at enrolment	Time-frame, months	Primary outcome	Intervention/comparator	Results
Borel <i>et al</i> ³⁵	France	Parallel RCT	OHS	37	1 month	Diurnal PaCO ₂	NIV/Lifestyle counselling	-3.5 mm Hg (95% CI -6.2 to -0.8) with NIV
Diuverman <i>et al</i> ³⁸	The Netherlands	Parallel RCT	COPD	67	6 months	Diurnal PaCO ₂	Home NIV initiation/in-hospital initiation	0.04 kPa (95% CI -0.31 to 0.38); non-inferiority of Home NIV initiation
Kelly <i>et al</i> ⁴¹	UK	Cross-over RCT	COPD/Chest Wall disorders/muscle weakness*	23	1 month	Overnight mean SpO ₂	Autotitrating NIV/standard non-invasive ventilation	96% (95-98) (IVAPS) versus 96% (93-97) (Standard PS); p=0.13
Diuverman <i>et al</i> ³⁸	The Netherlands	Cross-over RCT	COPD	14	1.5 months	Cardiac output	Low-intensity NIV/high-intensity NIV	Treatment effect HI versus-LI: -8.5% (95% CI -27 to 10) p=0.33
Diuverman <i>et al</i> ³⁷	The Netherlands	Parallel RCT	COPD	72	3 months	Health-related quality of life, evaluated with the Chronic Respiratory Questionnaire (CRQ)	NIV +pulmonary rehabilitation/pulmonary rehabilitation	7.5 points in favour of NIV +rehabilitation (95% CI 21.0 to 16.0) p=0.08
Masa <i>et al</i> ³⁴	Spain	Parallel RCT	OHS	221	2 months	Diurnal PaCO ₂	NIV versus CPAP versus lifestyle modifications	-5.5±7 mm Hg (NIV); -3.7±6.6 mm Hg (CPAP); -3.2±6 mm Hg (control); p value of adjusted intergroup differences=0.034
Masa <i>et al</i> ⁴³	Spain	Parallel RCT	OHS	86	2 months	Diurnal PaCO ₂	NIV versus lifestyle modifications	-6 mm Hg (95% CI -7.7 to -4.2) (NIV) versus -2.8 mm Hg (95% CI -4.3 to -1.3) (control); (p<0.001)
Murphy <i>et al</i> ⁴⁴	UK	Parallel RCT	OHS	50	3 months	Diurnal PaCO ₂	Volume targeted versus pressure support NIV	Mean difference between treatments (95% CI): -0.1 kPa, 95% CI 0.7 to 0.6, p=0.87).

*Only data from patients with COPD and OHS patients underwent meta-analysis.

HI, high intensity; IVAPS, intelligent volume-assured pressure support; Kpa, kilopascal; LI, low intensity; NIV, non-invasive ventilation; OHS, obesity hypoventilation syndrome; PS, pressure support; RCT, randomised controlled trial; SpO₂, capillary oxygen saturation.

relating to mask type were missing for 96 participants. In the 8 RCTs that were eligible for meta-analysis, 249 participants (86%) out of 290 used an oronasal mask.^{32 34 35 37 38 41 43 45}

Primary outcome: effect of mask type on PaCO₂

Complete data from 266 patients (92%) were available for the analysis of the effect of mask type on PaCO₂. The results of the mixed model showed that there was no effect of mask type on PaCO₂ (0.61 mm Hg (95% CI -2.15 to 3.38); p=0.68) (see online supplement, e-table 2). Marginal means calculated from the mixed model are presented in figure 2A. Similarly, the two step meta-analysis depicted in figure 3A found no association between mask type and PaCO₂ at endpoint (0.51 mm Hg (95% CI -1.60 to 2.62)). Heterogeneity was moderate (I²=50%) and was mainly caused by the contrasting results from the trials by Diuverman *et al*^{32 37 38} and Masa *et al*^{34 43} and the high variability in the trial by Kelly *et al*.⁴¹

Secondary outcomes: effect of mask type on PaO₂, NIV adherence and settings

Complete data from 255 (88%), 262 (90%), 269 (93%) and 238 (82%) participants were available for the analysis of PaO₂, daily adherence, and IPAP and EPAP levels, respectively. The results of the mixed models showed that there were no differences in the effect of mask type on PaO₂, NIV adherence or EPAP level. IPAP level was 1.87 cm H₂O lower with nasal masks in the unadjusted model (95% CI 0.44 to 3.30; p=0.01), but this difference

was no longer statistically significant in the adjusted model (see online supplementary e-table 2). The marginal means of the fully adjusted mixed model for these secondary outcomes are displayed in figure 2B-E for both types of mask.

The two steps meta-analysis presented in figure 3B,C and online supplemental e-figure 2 depicts the lack of association between mask type and PaO₂ at endpoint, NIV adherence and EPAP level. The two step meta-analysis presented in online supplemental e-figure 3 shows that nasal masks were associated with lower IPAP levels than oronasal masks (1.73 mm Hg (95% CI 0.17 to 3.28)). Heterogeneity was low (I²=24%).

A sensitivity analysis that included only the trials with moderate to low risk of bias^{32 34 35 41 43 45} found no difference between the type of masks on the outcomes of interest (online supplemental e-table 5)

Interaction between mask type and underlying pathology

There were no interactions between the underlying pathology (COPD/OHS) and the effect of mask type (nasal/oronasal) on the primary or any of the secondary outcomes (online supplemental e-table 3; and e-figures 4-8). There were also no interactions between mask type and duration of follow-up on the outcomes (online supplemental e-table 4).

DISCUSSION

This IPD meta-analysis compared the efficacy of nasal and oronasal masks used with home NIV in people with COPD or

OHS, and found no statistical difference between the two types of interface in terms of PaCO₂, PaO₂ or adherence. The results also showed that oronasal masks were used in the majority of cases (86%).

These findings are consistent with recent studies that reported the preferential use of oronasal masks for long term NIV at home,^{2 12 34 50} in contrast with studies published in the 2000's that showed a much greater use of nasal masks.^{51 52} This complete shift in practice over the last 20 years could be attributed to several factors. First, technological advances in the manufacturing process have increased the supply of high-quality oronasal masks. Second, in spite of heterogeneous practices among countries, NIV is initiated during an episode of acute respiratory failure in more than 50% of patients with COPD^{12 53} or OHS.^{54 55} In this situation, NIV is delivered via an oronasal mask because of the associated mouth breathing.⁵⁶ Oronasal masks may also be more appropriate if higher pressures are required for the reduction of CO₂. In general, once a patient has begun to use an oronasal mask, a shift back to a nasal mask is rarely considered. This is further illustrated by the fact that, among the four studies^{7 40 45 48} which evaluated continued NIV after an acute episode (for which mask-type data were available), oronasal masks were used in all cases. Finally, and more speculatively, nasal masks may lengthen the period of adaptation to NIV, which opposes the ongoing need to reduce the length of hospital stays.

Recent guidelines for long-term home NIV in patients with COPD reported that oronasal masks are used more often as they provide better alveolar ventilation than nasal masks, especially

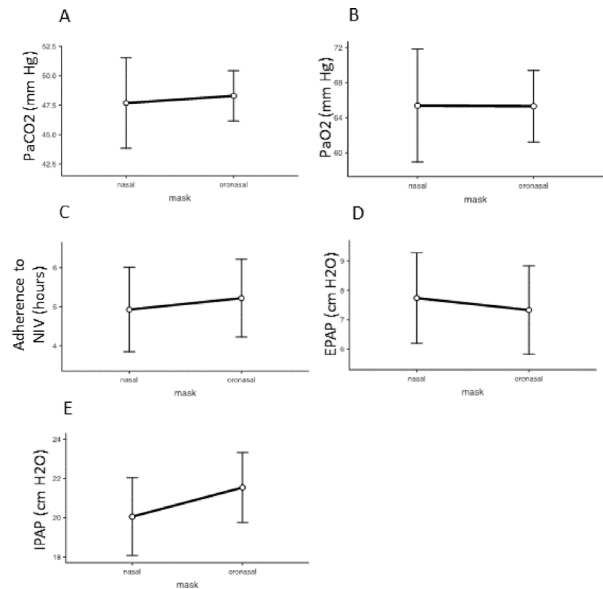


Figure 2 Marginal means of the fully adjusted mixed model are presented for the five outcomes according to the type of mask. (A) for PaCO₂; (B) for PaO₂; (C) for adherence to non-invasive ventilation (NIV); (D) for expiratory positive airway pressure (EPAP) and (E) for inspiratory positive airway pressure (IPAP).

when high levels of inspiratory pressure are used.⁵⁷ This is not supported by the results of the meta-analysis: improvements in PaCO₂ and PaO₂ were not greater with oronasal masks. However, the two-stage meta-analysis highlighted that the results for PaO₂^{32 37} in two studies, and for PaCO₂^{32 37 38} in three studies (all conducted in patients with COPD) behaved differently from the results of the other studies, contributing to the heterogeneity of the overall results. Those three studies also had the longest time frames and were conducted by the same group in the Netherlands.

Similarly to previous studies, the results suggested that higher levels of mean inspiratory pressure are required with oronasal compared with nasal masks.^{12 14} In contrast, there was no effect of mask type on expiratory positive pressure, contrary to many studies and meta-analyses that showed that oronasal masks are associated with higher levels of CPAP in patients with sleep apnoea syndrome.²⁶ Although the reasons for these differences require further investigation, we tentatively hypothesise that under NIV, the higher level of inspiratory pressure counteracts the effect of the backward position of the mandible induced by oronasal masks.

Another finding that contrasted with previous reports was the lack of effect of mask-type on adherence to NIV. Studies in patients with OSA syndrome found that CPAP adherence is lower with oronasal masks.^{20 26} This discrepancy could be due to the fact that during CPAP treatment, oronasal masks are recommended as a second-line interface in case of failure with a nasal mask,⁵⁸ whereas during NIV, as discussed above, oronasal masks are commonly introduced at treatment initiation.

The main strength of this meta-analysis is that it was conducted on individual patient data from RCTs with consistent assessment of outcomes, controlled timeframes, and a low rate of missing data. Moreover, the use of individual data allowed the same fully adjusted model to be used for all the studies included, and the use of both a one-step and a

Table 2 Baseline characteristics according to type of mask and diseases

Characteristics	Nasal (n=41)	Oronasal (n=249)	P values
Male, n (%)			
COPD	4 (21.1)	48 (53.3)	0.12
OHS	9 (40.9)	62 (39.7)	
Age (years)			0.95
COPD	62.1 (9.61)	61.5 (11.00)	
OHS	64.0 (9.94)	63.9 (8.17)	
BMI (kg·m ²)			0.13
COPD	35.4 (10.60)	38.3 (11.70)	
OHS	26.3 (5.75)	26.2 (5.52)	
FEV ₁ , L			0.80
COPD	1.54 (0.98)	1.56 (0.92)	
OHS	0.74 (0.29)	0.68 (0.30)	
FVC, L			0.74
COPD	2.24 (0.81)	2.06 (0.77)	
OHS	2.59 (0.92)	2.49 (0.90)	
COPD	2.33 (0.74)	2.39 (0.82)	
OHS	2.81 (1.02)	2.55 (0.95)	
PaCO ₂ , mm Hg			<0.001
COPD	49.1 (4.12)	52.4 (5.89)	
OHS	49.7 (4.43)	54.8 (6.91)	
OHS	48.5 (3.85)	51.1 (4.75)	
PaO ₂ , mm Hg			0.008
COPD	65.2 (11.7)	60.6 (11)	
OHS	61.2 (10.7)	55.1 (10.7)	
OHS	68.6 (11.6)	63.8 (10.0)	

Results are expressed as means and SD.

*Data from three patients were missing.

BMI, body mass index; F, female; M, male.

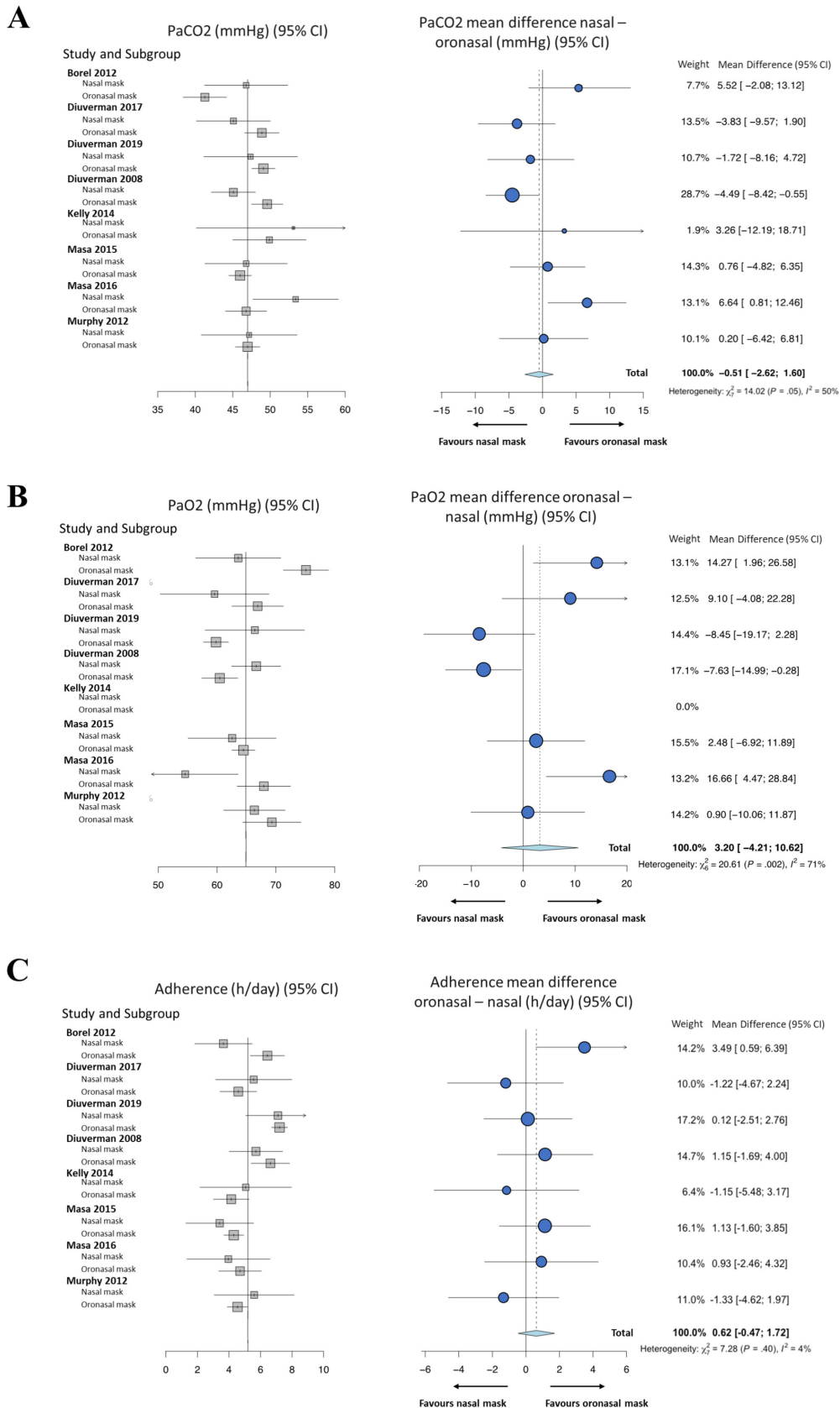


Figure 3 Summary results of the two step meta-analysis for (A) PaCO₂, (B) PaO₂ and (C) non-invasive ventilation (NIV) adherence. The results for each type of mask in each study are displayed on the left forest plot and the interaction between mask type and the effect on the outcomes at the end of the studies are displayed on the right forest plot. Results are presented using mean differences and 95% CI. Squares are used to depict effects and circles to depict the interaction effects, with sizing in proportion to the inverse of the variance of the estimates. Random effect models were used for PaCO₂ and PaO₂. Fixed effect model was used for adherence.

two-step approach to meta-analysis strengthens the robustness of the findings.

However, the study also has several limitations. First, it is important to remember the summary of GRADE's approach showed that the overall quality of the findings was very low. Second, individual data were only requested for participants included in the NIV groups of the trials; thus, the efficacy of each type of mask could not be evaluated against the control arm. Moreover, of the 18 RCTs with available IPD, 10 were excluded^{7 36 39 40 42 44 46–49} because only one type of mask was used or because data regarding the type of mask used were not available, which may have led to selection bias. This risk of selection bias may have been amplified by the fact that, in the studies included, the interfaces were not randomised but rather clinician and/or patient dependent; the studies were not designed to compare nasal versus oronasal masks. This is the reason why a meta-analysis on aggregated data was not feasible and that we chose to perform a meta-analysis on IPD. Lastly, although the maximum number of available variables was included in the model, visual analysis of the data presented in table 2 suggests that patients with more severe disease might be preferentially prescribed oronasal masks. This raises the question of the criteria used in the decision of mask choice. Furthermore, NIV modes as well as details of NIV settings (eg, respiratory rate, inspiratory and expiratory triggers) and leaks were not collected in this IPD design. Residual unmeasured confounding is likely and could explain the heterogeneity found in the meta-analysis.

The inclusion of studies of two very different conditions, COPD and OHS, could be considered as a limitation. However, this choice was based on several factors: (1) although the NIV settings differ between these two conditions, there are no clinical reasons for basing the choice of interface on the underlying condition, and (2) the main outcomes used in NIV studies were identical for both conditions (PaCO₂, PaO₂ and adherence). Furthermore, the statistical analysis showed that there were no interactions between the underlying condition and the choice of interface at the selected endpoints. However, it is important to keep in mind that OHS and COPD are very different in terms of clinical presentation and comorbidities; therefore, further studies are required within each of these specific pathologies to confirm these results. Finally, the predefined outcomes of this study focused on the treatment of chronic respiratory failure. Other important outcomes such as quality of life, sleep quality, tolerance and cardiovascular-related adverse events were not assessed; this should be included in future trials.

CONCLUSION

This meta-analysis demonstrated that, although oronasal masks are the most commonly used interfaces for home NIV treatment in patients with OHS and COPD, there is no difference in the efficacy or tolerance of either nasal or oronasal masks. However, this supports the need for pragmatic randomised, non-inferiority clinical trials to confirm these results. Once robust data have been obtained, recommendations to guide the choice of mask for home NIV could be formulated.

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