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Review Article

Impact of Inadequate Nutrition in Lung Transplant Recovery: A Meta-Analysis

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Abstract

Background: We aimed to appraise and compare the impact of inadequate nutrition in lung transplant recovery.

Methods: Based on the inspection of the meta-analysis data, the odds ratio (OR) and mean difference (MD) with 95% confidence intervals (CIs) were derived by dichotomous random or fixed effect models. 6 papers with 1399 lung transplant who were available between 2020 and 2024 were comprised in this meta-analysis.

Results: Frail had significantly higher hospital length of stay (MD, 2.80; 95% CI, 1.80-3.80, $P< 0.001$), and all-cause mortality (OR, 2.33; 95% CI, 1.40-3.87, $P=0.001$) compared to non-frail in subjects with lung transplant. However, no significant difference was found between frail and non-frail in intubation post-lung transplant (MD, 7.00; 95% CI, -17.52-31.52, $P=0.58$), and intensive care unit length of stay (MD, -1.70; 95% CI, -4.53-1.14, $P=0.24$) in subjects with lung transplant.

Conclusion: Using frail had significantly higher hospital length of stay, and all-cause mortality, however, no significant difference was found in intubation post-lung transplant, and intensive care unit length of stay compared to non-frail in subjects with lung transplant However, given that comparisons comprised a small number of studies, attention ought to be given to their values.

Keywords: Lung transplant; Hospital; Intubation post-lung transplant; Frail; All-cause mortality; Intensive care

Introduction

Globally, chronic lung illness has a substantial negative impact on people's health, well-being, and economy. When all other choices for treating a particular type of end-stage lung illness have been exhausted, lung transplantation is a very successful treatment. Both a longer life expectancy and an improved quality of life are possible outcomes of lung transplantation. Over the past ten years, there has been a significant rise in the frequency of lung transplants because of improved donor lung preservation procedures and surgical approaches that increase the number of viable organs (1). Due in large part to significant advancements in the diagnosis and treatment of primary graft failure, types of cellular and antibody-mediated rejection, chronic lung allograft dysfunction, and infection, both short- and long-term lung transplantation outcomes have continued to improve (2). After lung transplantation, the anticipated survival percentage is roughly 40% after ten years and 60% after five (3). The lack of available donor organs continues to be a major obstacle for patients in need of transplants, even with advancements in lung transplantation (4). Because of this, the death rate among candidates for lung transplants is significant, with 15%-20% of them passing away before receiving a transplant (3). Thus, only those who have a reasonable chance of living a long and satisfactory life after transplantation should be considered for lung transplantation. The onset of frailty may be preceded by sarcopenia, the loss of skeletal muscle mass, and the corresponding deterioration in physical function (5). Sarcopenia and frailty are frequent in the setting of chronic respiratory illness. There is a complicated overlap between the main traits of frailty and sarcopenia. Sarcopenia and frailty, however, may represent different clinical phenotypes (6). A multifactorial illness called frailty causes a reduction in physiological reserve. This leads to a reduced capacity to tolerate mild stresses and has been linked to mortality, hospitalization, disability, and functional impairment (7). This state of weakness is recognized by frailty assessment, which also offers an objective, indiscriminate evaluation of the vulnerability of the patient. Different operational definitions have been put out to quantify frailty, and the risk profiles detected by each technique vary slightly (8). Frailty in different populations can be measured using a number of validated instruments (7). The frailty deficit index model, created by Rockwood et al. (9), defines frailty as the percentage of deficits that are present and is based on the idea that frail patients have functional and health-related "deficits" (10). Up to 70 potential deficits are included in the various frailty deficit indexes that have been established (10). Frailty is defined by the phenotypic model as the presence of three or more of the following five criteria: low energy expenditure, slow gait speed, unintended weight loss, weakness, and self-reported weariness (11). A reliable instrument for assessing lower extremity function, such as walking speed, chair stands, and balance, is the Short Physical Performance Battery (12). The relationship between frailty and chronic respiratory disease has been examined in a number of recent review papers (6). In chronic respiratory diseases, frailty is prevalent and is linked to poor functional status, disability, illness severity, poor health-related quality of life, and mortality (6). When it comes to chronic respiratory diseases, evaluating frailty might help identify patients who may benefit from preventative measures because they are more likely to experience higher morbidity and mortality (6). The purpose of this review was to investigate the relationship between frailty and lung transplant recipients in particular. A complicated treatment, lung transplantation carries a high risk of perioperative morbidity and mortality. One of the main factors influencing results is the selection of lung transplant candidates. It is a complicated decision to list for a lung transplant, requiring evaluation of program-specific, clinical, and psychosocial aspects (4). The complex procedure to identify suitable candidates for lung transplantation needs to carefully take into account the special characteristics of each patient and transplant program (13). Making sure organs are allocated appropriately maximizes the benefits of such a limited resource and is a difficult duty (4). Age is one of the main areas where there have been noticeable shifts in the absolute and relative contraindications to lung transplantation over time (1). Growing older is no longer regarded as a strict no for receiving a transplant. According to current international guidelines, all lung transplant candidates should have their physiological reserve evaluated (4).

This article attempts to provide a comprehensive review of papers that have evaluated frailty during lung transplant evaluation.

Methods

Design of the examination

The meta-analyses were estimated and combined with the epidemiological statement using a predefined procedure (14). Several databases, including the Cochrane Library, PubMed, OVID, Google Scholar, and Embase, were accessed in gathering and analyzing the data (15-18). These datasets were applied to collect analyses that compared and assessed the impact of inadequate nutrition in lung transplant recovery (19).

Data pooling

Inadequate nutrition that causes frail produced several clinical results. In this research, the main consequence of the inclusion parameter was analyzed. Language obstacles were not taken into account during the inclusion of research or the screening process for potential participants (20). There were no restrictions on the quantity of volunteers that could be found for the research. Since letters, reviews, and editorials do not present a position in the meta-analysis, we did not integrate this kind into our creation. Figure 1 illustrates the complete inspection identification process.

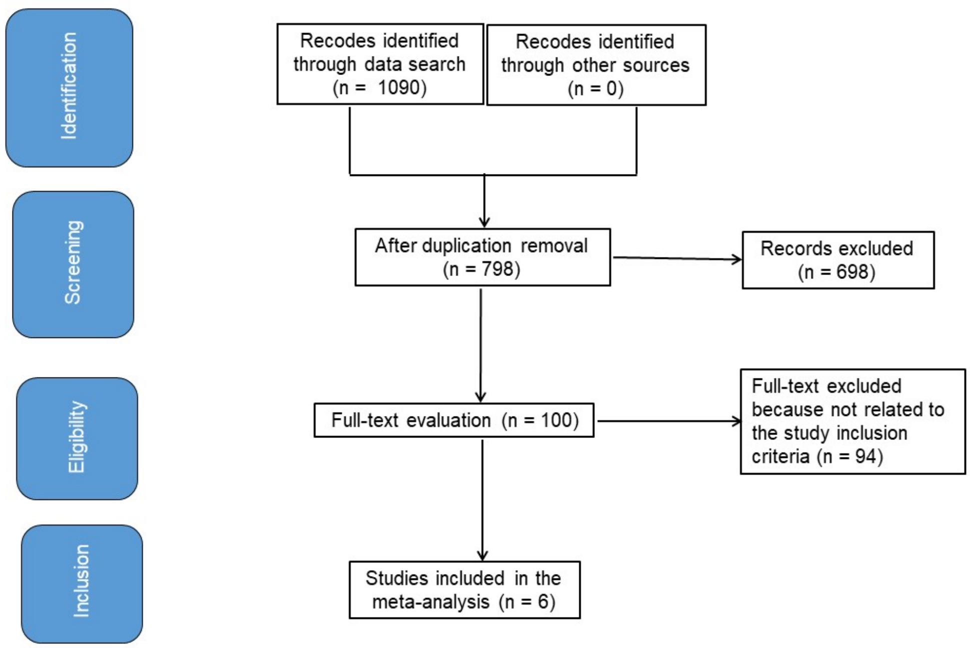

Fig. 1: Schematic diagram of the examination procedure

Eligibility of included studies

The impact of inadequate nutrition in lung transplant recovery was studied. Only examinations that talked about how interferences influenced the incidence of different clinical results were included in the sensitivity analysis. Subclass and sensitivity analyses were implemented by associating the numerous subtypes with the interference groups.

Inclusion and exclusion criteria

Inclusion criteria and exclusion criteria

Figure 1 is an overall study representation. When the inclusion criteria were satisfied, the literature was incorporated into the study (14, 20, 21):

1. The research was a randomized controlled study, observational, retrospective, and prospective.

2. Subjects with lung transplant were the investigated elect subjects.
3. The interference incorporated inadequate nutrition that cause frail.
4. The study demonstrates the eminent impact of inadequate nutrition in lung transplant recovery (15).

The exclusion of non-comparative study designs occurred.

Identification of studies

A protocol of search algorithms was established and specified by the PICOS principle (22), which states: P (population) Subjects with lung transplant; Inadequate nutrition that cause frail was the "interference" or "exposure"; C (comparison): the comparison among frail and non-frail. O (outcome): different clinical results; S (design of the examination): the planned valuation was unlimited (23). By using the keywords in Table 1, we led a thorough exploration of the applicable databases through Jul 2024. Appraisals were led on the entire articles encompassed in a reference management program, comprising Author, titles, and abstracts. Moreover, two authors assess publications to detect appropriate tests (17, 18, 24).

Table 1: Database Search Strategy for inclusion of examinations

Database	Search strategy
Google Scholar	#1 "lung transplant" OR "hospital length of stay" #2 "intubation post-lung transplant" OR "frail" OR " "all-cause mortality" OR "Intensive care unit length of stay" #3 #1 AND #2
Embase	#1 'lung transplant' /exp OR 'hospital length of stay' /exp OR 'all-cause mortality' #2 'intubation post-lung transplant'/exp OR 'frail'/exp OR 'Intensive care unit length of stay' #3 #1 AND #2
Cochrane library	#1 (lung transplant):ti,ab,kw (hospital length of stay):ti,ab,kw (all-cause mortality):ti,ab,kw (Word variations have been searched) #2 (intubation post-lung transplant):ti,ab,kw OR (frail):ti,ab,kw OR(Intensive care unit length of stay):ti,ab,kw (Word variations have been searched) #3 #1 AND #2
Pubmed	#1 "lung transplant"[MeSH] OR "hospital length of stay"[MeSH] OR "all-cause mortality" [All Fields] #2 "intubation post-lung transplant"[MeSH Terms] OR "frail"[MeSH] OR "Intensive care unit length of stay "[All Fields] #3 #1 AND #2
OVID	#1 "lung transplant"[All Fields] OR "hospital length of stay" [All Fields] OR "all-cause mortality" [All Fields] #2 "intubation post-lung transplant"[All fields] OR "frail"[All Fields] or "Intensive care unit length of stay"[All Fields] #3 #1 AND #2

Screening of studies

The investigation is given in a regular format, along with each of its component features. First author's last name, the study's date, the nation in which it was taking place, femininity, type of population that was employed for meta-analysis, total number of subjects, clinical and treatment characteristics, demographic information, and qualitative and quantitative evaluation methods were some criteria applied to decrease the data (25). Two authors looked into the opportunity for bias in the studies and the standard of approaches utilized in papers elected for supplementary analysis. The two authors conducted unbiased reviews of techniques used for each test (26).

Statistical analysis

In this meta-analysis, the odds ratio (OR), and mean difference (MD) with a 95% confidence interval (CI) were estimated utilizing dichotomous random- or fixed-effect models (22). Calculated I2 index has a range of 0 to 100 and is expressed as a percentage (25). Higher I2 values signify increased heterogeneity, whilst lower I2 values signify decreased heterogeneity. If I2 was 50% or above, the random effect was selected; otherwise, a fixed effect was chosen (27). The first study's consequences were classified as a component of the subcategory analysis. Bias was measured using Begg's and Egger's tests utilized for quantitative analysis, and it was considered to exist if P>0.05. (28, 29) P-values were calculated by a two-tailed approach. With Review Manager 5.4, graphs and statistical analyses were created (16).

Results

After examining 1090 pertinent publications, 6 research that were published between 2020 and 2024 content the requirements and were encompassed in this study (30-35).

Table 2 condenses the discoveries of these studies. 1399 persons were studied.

Table 2: Characteristics of studies

Study	Country	Total	Frail	Non-frail	Study type	Frailty measure
Montgomery et al 2020 (30)	Australia	69	13	56	Multicenter Observational prospective cohort study	Short physical performance battery; Fried frailty phenotype
Montgomery et al 2020 (31)	Australia	193	27	166	Single center prospective cohort study	Modified fried frailty phenotype
Guler et al 2020 (32)	Canada	421	272	149	Multicenter observational prospective cohort study	Short physical performance battery; Fried frailty phenotype
Farooqi et al 2021 (33)	Canada	205	123	82	Single center prospective cohort study	Short physical performance battery; Fried frailty phenotype
Singer et al 2023 (34)	USA	422	89	333	Single center prospective cohort study	Short physical performance battery; Fried frailty phenotype
Van Hollebeke et al 2024 (35)	Canada	89	31	58	Multicenter observational Prospective cohort study	Short physical performance battery; Fried frailty phenotype
	Total	1399	555	844		

Frail had significantly higher hospital length of stay (MD, 2.80; 95% CI, 1.80-3.80, P<0.001) with low heterogeneity (I^2=42%), and all-cause mortality (OR, 2.33; 95% CI, 1.40-3.87, P=0.001) with no heterogeneity (I^2 =9%) compared to non-frail in subjects with lung transplant, as shown in Figs. 2 and 3. However, no significant difference was found between frail and non-frail in intubation post-lung transplant (MD, 7.00; 95% CI, -17.52-31.52, *P*=0.58) with no heterogeneity (I^2=0%), and intensive care unit length of stay (MD, -1.70; 95% CI, -4.53- 1.14, *P*=0.24) with no heterogeneity (I^2=0%) in subjects with lung transplant, as shown in Figs. 4 and 5.

The quantitative Egger regression test and the visual interpretation of the effect's forest plot revealed no indication of investigation bias (*P*=0.86). The mainstream of pertinent exams had poor practical quality and were prejudiced in their selective reporting. As shown in Figs. 2-5 most of the comparisons had high heterogeneity. That affected the effect model chosen and so affected the results of the comparison.

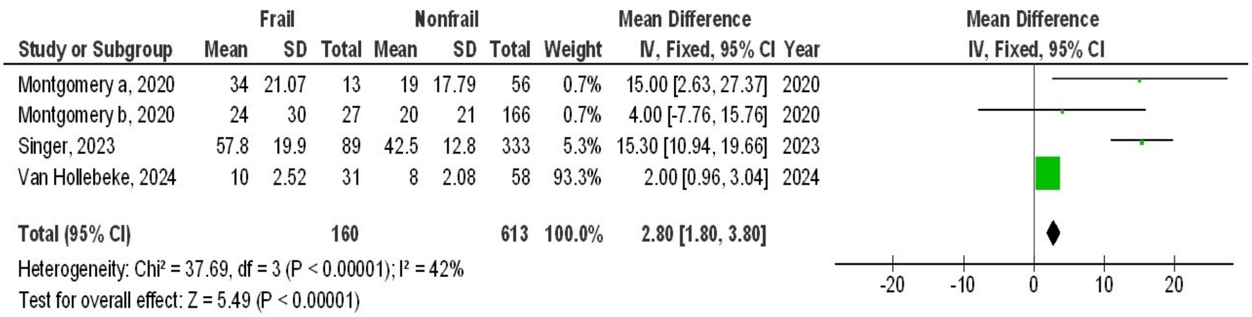

Fig. 2: The effect's forest plot of the frail on hospital length of stay compared to non-frail in subjects with lung transplant

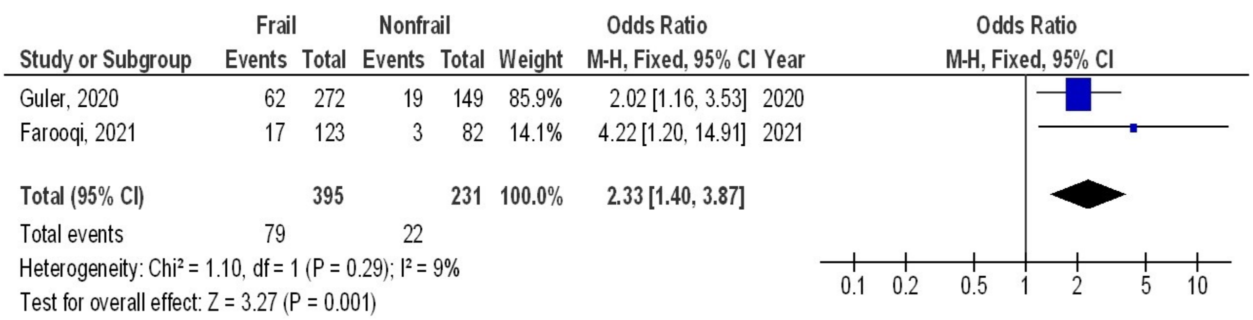

Fig. 3: The effect's forest plot of the frail on all-cause mortality compared to non-frail in subjects with lung transplant

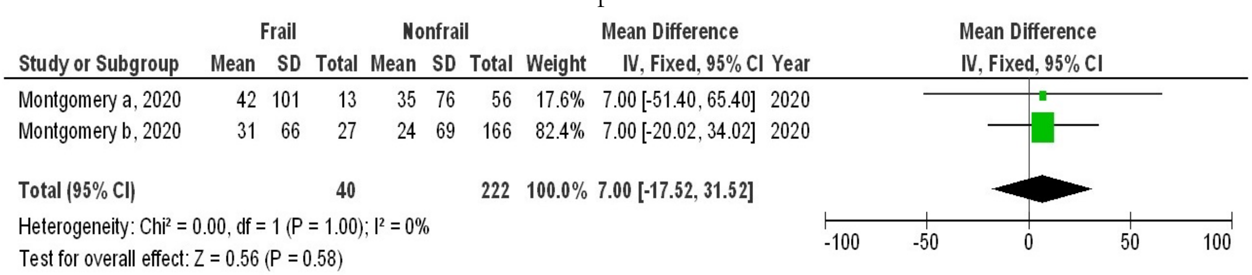

Fig. 4: The effect's forest plot of the frail on intubation post-lung transplant compared to non-frail in subjects with lung transplant

Study or Subgroup	Frail Mean	Frail SD	Frail Total	Nonfrail Mean	Nonfrail SD	Nonfrail Total	Weight	Mean Difference IV, Fixed, 95% CI	Year
Montgomery b, 2020	4	8.39	13	7	5.69	56	34.9%	-3.00 [-7.80, 1.80]	2020
Montgomery a, 2020	4	9	27	5	6	166	65.1%	-1.00 [-4.52, 2.52]	2020
Total (95% CI)			**40**			**222**	**100.0%**	**-1.70 [-4.53, 1.14]**	

Heterogeneity: Chi² = 0.43, df = 1 (P = 0.51); I² = 0%
Test for overall effect: Z = 1.17 (P = 0.24)

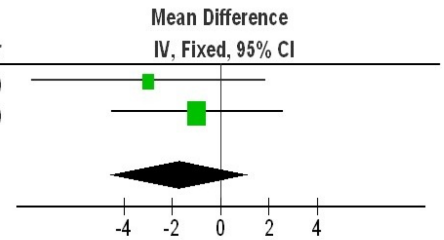

Fig. 5: The effect's forest plot of the frail on intensive care unit length of stay compared to non-frail in subjects with lung transplant

Discussion

For the current meta-analysis, six research that were published between 2020 and 2024 were included; of these, 1399 people were studied (30-35).

The using frail had significantly higher hospital length of stay, and all-cause mortality compared to non-frail in subjects with lung transplant. However, no significant difference was found between frail and non-frail in intubation post-lung transplant, and intensive care unit length of stay in subjects with lung transplant. However, comparisons included a small number of studies, three of them included only two studies, and thoughtfulness ought to be prearranged to their values (36-51).

In many medical and surgical groups, the degree of frailty is a strong predictor of unfavorable outcomes (52). The substantial correlation between frailty and morbidity and mortality both before and after lung transplantation is highlighted in this meta-analysis (30-35). In other solid organ transplant groups, frailty has been linked to morbidity and mortality. In all patients, both pre- and post-transplant, fragility is independently linked to higher 1-year mortality after referral for heart transplant assessment (53). In the population receiving liver transplants, frailty is linked to higher waiting and post-transplant mortality (54). Pre-transplant fragility is linked to a higher risk of graft failure and delayed graft function in recipients of kidney transplants (55). The development of targeted therapies to address frailty in lung transplant candidates and recipients may be aided by the identification of reversible features of frailty. Interventions can be used to address frailty both before and after lung transplants. Potential intervention areas for the treatment of frailty include exercise, nutritional assistance, and vitamin D deficiency (56). Exercise, particularly resistance and aerobic training, improves functional performance, symptom burden, and general health status in those who are considered fragile. Completing pulmonary rehabilitation has been demonstrated to reverse frailty as measured by the Fried Frailty Phenotype in a cohort with chronic obstructive pulmonary disease (57). Physical fragility, as measured by the Short Physical Performance Battery and Fried Frailty Phenotype, improved in a small pilot research involving lung transplant candidates and a home-based rehabilitation intervention (58). Frailty prevalence was found to be 0% by Courtwright et al. (59). In their second study, 16% of subjects were classified as pre-fragile, and a prevalence of 0% was once again recorded. Weak candidates are enrolled in rehabilitation programs rather than being listed in their program. In order to support the idea that frailty is reversible with the right care, candidates must demonstrate improvement in their Short Physical Performance Battery to at least the prefrail condition. More than 80% of adult lung transplant recipients deemed weak at listing were not considered frail when reassessed after the transplant (60). In most lung transplant candidates, frailty may be related to advanced lung disease and may be reversed with a transplant. However, it's crucial to distinguish between frailty brought on by illness and frailty that is unlikely to improve after transplantation, putting candidates at increased risk of death and morbidity. Lung transplant candidates frequently have nutritional deficiency, linked to higher rates of morbidity and death both before and after lung transplantation (61). Protein-calorie supplements were found to improve outcomes in a group of individuals with chronic obstructive pulmonary disease (62). Future studies in the management of frailty in lung transplant candidates should incorporate nutritional supplementation and consultation with a nutrition specialist, according to a recent consensus statement (63). Supplemental vitamin D has been demonstrated to enhance muscle performance in older persons, and vitamin D insufficiency is linked to falls, impaired muscle function, and death (64). According to a recent consensus statement, vitamin D levels should be taken into consideration when evaluating nutritional status and frailty in lung transplant candidates. (63) Future studies in the optimization of frailty may focus on the regulation of vitamin D levels. The lack of a meta-analysis, the small body of research on frailty in lung transplantation are some of the meta-analysis's shortcomings.

Limitations

Given that a few of the researchers selected for the meta-analysis were not included, assortment bias may have occurred. However, the excluded studies did not meet the necessary standards to be incorporated into the meta-analysis. Moreover, we lacked the information necessary to conclude if certain features e.g., race, gender, and age had an impression on consequences. Finding out how ongoing maintenance and intervention might impact of inadequate nutrition in lung transplant recovery was the aim of the study. The poor quality of included studies, heterogeneity, and publication bias are parts of the limitations of this meta-analysis. Bias may have been increased as a result of incomplete or erroneous data from earlier studies being included. Age, gender, race, and nutritional status of the subjects were likely sources of bias. Unintentionally skewed values could be the consequence of incomplete data and unpublished research.

Conclusion

The using frail had significantly higher hospital length of stay, and all-cause mortality compared to non-frail in subjects with lung transplant. However, no significant difference was found between frail and non-frail in intubation post-lung transplant, and intensive care unit length of stay in subjects with lung transplant. However, comparisons comprised a small number of studies, three of them included only two studies, and thoughtfulness ought to be prearranged to their values.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Availability of data and materials

On request, the corresponding author is required to provide access to the meta-analysis database.

Conflict of Interest

The authors declare that there is no conflict of interests.

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