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Original Article

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Effects of Facial Exercise for Facial Muscle Strengthening and Rejuvenation: Systematic Review

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Purpose: The mass of facial muscles can be increased through exercise, as is also the case for muscles in the extremities. This systematic review was conducted to investigate the effect of facial exercises on facial muscle strengthening and facial rejuvenation, focusing on recent studies.

Methods: A literature search was performed using the PubMed, ScienceDirect, and Web of Science databases. The quality of the trials was evaluated according to the PEDro scale. In total, 11 studies were included in this review: four studies on facial exercise for facial rejuvenation and seven studies on strengthening the muscles of the face.

Results: Facial exercises for facial rejuvenation increased the mechanical properties and elasticity of the skin of the face and neck, the thickness and cross-sectional area of the facial muscles, and the fullness of the upper and lower cheeks.

Conclusion: A study aimed at strengthening facial muscles showed improvements in labial closure strength and tongue elevation strength. Despite the positive results for facial rejuvenation and muscle strengthening, the level of evidence was low. Therefore, in future research, it will be necessary to investigate the effects of facial exercise in a thoroughly controlled experiment with a sufficient sample size to increase the level of evidence.

Keywords: Facial exercises, Facial rejuvenation, Skin elasticity, Lip strength training

INTRODUCTION

Facial aging includes skin sagging and the loss of deeper substructural volume of fat and muscle.[1] As the average life expectancy is extended, a youthful appearance is becoming more important, and substantial efforts are being made to improve and correct facial aging.[2-4]

Both invasive and non-invasive methods are used to improve facial aging. Invasive methods replicate a youthful external appearance, but generally do not meaningfully contribute towards addressing or preventing the underlying causes of facial aging.[5,6] Non-invasive approaches can be applied as either supplements or alternatives to invasive facial rejuvenation methods.[7] These alternative approaches are less invasive, inexpensive, and can usually be performed by non-medical specialists.[8]

Facial exercises, which incorporate various strengthening movements and manipulations of facial muscles, are another approach to rejuvenation that aims to reduce facial skin sagging by strengthening facial muscle tone.[8] Facial exercises have been suggested to stimulate tissue regeneration by promoting circulation to the facial muscles and enabling generated waste products to be drained more effectively.[9]

However, in previous studies, inconsistent results have been reported regarding whether facial muscle exercises are effective for facial rejuvenation.[9] In a systematic review, Van Borsel et al.[10] reported that favorable and statistically significant volume changes were observed around the upper lip, jawline, and cheeks in response to repetitive isometric exercises. They also reported that facial exercise equipment could lead to subjective improvements of the degree of wrinkles, tone, and complexion.[9,11] However, studies investigating the effects either positive or negative of facial exercises for facial rejuvenation have reported a low level of evidence.[9,11,12]

Kim et al.[13] reported that facial exercises increased the cross-sectional area of facial muscles, making the muscles stronger and shorter and the attached skin firmer and more elastic, and that there was a direct relationship between increased facial muscle strength and improved skin elastici-

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ty. The movement of muscles during exercise increases muscle mass and decreases fat infiltration into the muscles.[14-16] Facial muscle mass, in turn, is closely correlated with facial youthfulness.[9,17]

The author expected that by actively utilizing the positive aspects of facial exercise, it will be possible to strengthen facial muscles and thereby induce improvements in skin elasticity and functional aspects. Therefore, this systematic review aimed to investigate the effects of facial exercise on facial muscle strengthening and facial rejuvenation more broadly, focusing on recent studies.

METHODS

1. Study Design

This study is a systematic review reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[18] Key data (PICO) was whether facial exercise (intervention) was better than pre-intervention (comparison) for facial muscle strengthening and rejuvenation (outcomes) for healthy persons 18 years of age or older (participants).

2. Database Source and Search Criteria

The search strategy was implemented in PubMed, ScienceDirect, and Web of Science, considering articles from June 2011 to June 2021. The databases were searched using the following key terms: "facial exercises and rejuvenation," "skin elasticity," "lip strength training," "wrinkles," and "aesthetic." The terms were established based on initial searches to find keywords (MeSH terms) with PubMed.

3. Inclusion and Exclusion Criteria

Articles meeting the following inclusion criteria were included in the systematic review: 1) English-language studies published in a peer-reviewed journal, 2) papers published within the last 10 years, 3) studies investigating the effects of facial exercise with quantitatively measured results, 4) studies wherein the exercise program involved voluntary isometric contractions and voluntary isotonic contractions, 5) studies with participants limited to healthy persons 18 years of age or older, 6) studies focusing on facial rejuvenation and facial muscle strengthening (studies on facial exercises in patients with head injuries, facial nerve palsy, or other pathological conditions were not considered), 7) and studies that applied exercises to the face manually or using tools. The exclusion criteria were 1) meta-analyses and review papers, and 2) studies using invasive methods (including facial surgery and combined treatment with injections or acupuncture).

4. Study Review Process and Data Extraction

Searches were performed independently in each database by the author, following the above-described search strategy. The author reviewed the titles and abstracts retrieved from all databases and determined whether each study met the inclusion criteria. The author then read the full text and strictly applied the inclusion and exclusion criteria to determine whether to include the study in the review.

5. Evaluation of Quality of the Studies

This study used the PEDro scale to evaluate the methodological quality of studies that met the inclusion criteria.[19] A PEDro score of 9-10 is considered to be excellent, 6-8 is good, 4-5 is fair, and a score of 4 or less is considered poor.[20]

RESULTS

In total, 2,334 records were identified through the search process. After 65 duplicate articles were removed, 2,269 articles remained. Then, 2,251 articles were excluded according to the inclusion and exclusion criteria. After this step, 18 articles remained. After screening titles and abstracts for relevance, 8 articles were excluded through an evaluation of the full text if necessary. One additional article was included based on a manual search of the reference lists, and 11 studies were finally included in the review.[8,9,12,13,17,21-26] The search process is detailed in Figure 1.

The total population of the 11 selected studies was n=290. Five of the studies had a control group, and the remaining six studies were single-arm, prospective, open-label trials. Four studies investigated the effect of facial exercise on rejuvenation, and the remaining seven papers investigated its effects on facial muscle strength and function (Table 1).

1. Facial Exercises for Rejuvenation

Facial exercises were found to increase the mechanical properties and elasticity of the skin of the face and neck, as well as the thickness and cross-sectional area of the facial muscles.[9,13] The feeling of fullness of the upper and lower cheeks also increased.[18] However, De Vos et al.[8] reported positive results only for the upper lip, with no significant difference between the experimental and control groups in the forehead, nasolabial fold, jawline, and lower jaw area. There was no control group in three papers on this topic (Table 1).

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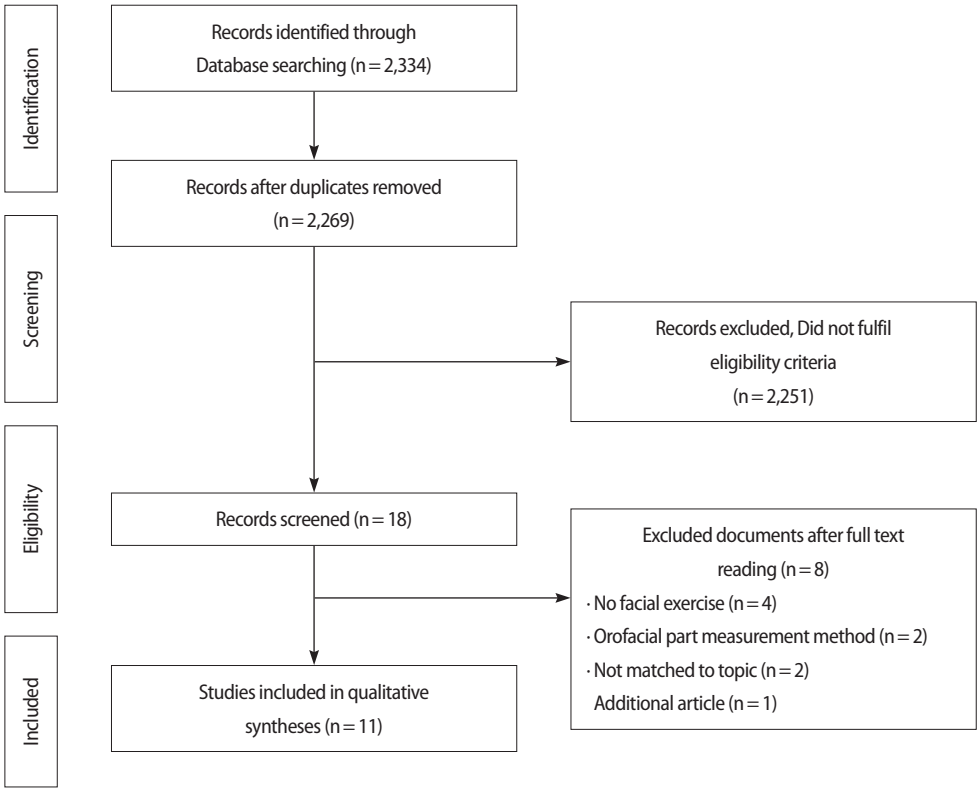

Figure 1. Flow chart.

2. Facial Exercises for Muscle Strengthening

Facial exercises increased labial closure strength, tongue elevation strength, and skin elasticity, as well as lip endurance, orbicularis oris endurance, and the sealed lip ratio.[12,21-25] Takamoto et al.[26] reported that lip closure training had various effects (improving lip closure dysfunction, ameliorating sleep apnea, and reducing daytime sleep through activation of the brain, including the prefrontal cortex) (Table 1).

3. Quality Assessment

The methodological quality of the 11 included articles was between 2 and 7, with a median value of 3.5 (Table 1). Overall, the methodological quality was poor.

DISCUSSION

This systematic review was conducted to investigate the effects of facial exercise on facial muscle strengthening and rejuvenation. Eleven articles were included: four on the effect of facial exercise on rejuvenation, and seven on the effects of facial exercise on muscle strengthening and function. The results of this review show that facial exercises for facial rejuvenation lead to improvements in the mechanical properties and elasticity of the skin of the face and neck, the thickness and cross-sectional area of the facial muscles, and upper and lower cheek fullness.[8,9,13,17] However, one study reported positive results only for the upper lip after 7 weeks of facial exercises, and with no significant difference between the experimental and control groups in the forehead, nasolabial folds, jawline, and area under the chin.[8] Van Lieshout et al.[27] reported that the facial muscle strength increased and the biomechanical extensibility of the facial skin decreased through progressive resistance exercises of the facial expression muscles. They suggested a direct correlation between improved skin elasticity and increased strength of the facial muscles became stronger. In one study in this review, 20 weeks of facial exercise therapy was shown to improve midfacial and lower facial fullness, leading to hypertrophy due to exercise of the cheeks and other muscles.[17] In addition, Kim et al.[9,11] reported that facial isometric exercise was effective in improving facial skin elasticity.[13] A previous study reported that facial muscle size increased in response to not only facial exercise, but also neuromuscular electrical stimulation or an oscillatory movement device. Kavanagh et al.[11] speculated that there may exist a relationship between the exercise-induced increase in zygomatic major muscle size and shortening of the resting length of the muscle,

Table 1. Summary of the included studies

Author, Year	Participants	Intervention	Outcome measures	Salient findings	PEDro score
De Vos MC et al., 2013	Women, N=18 (9 experimental and 9 control), mean age of experimental group=47 years (range: 40-55 years), and mean age of control group=46 years (range: 39-60 years)	Four isometric exercises (targeted muscles: frontalis, orbicularis oris, zygomaticus minor, and sternocleidomastoid and mylohyoid muscles) conducted daily for 7 weeks	Photographs, visual analogue scale: comparison of facial areas (forehead, nasolabial folds, area above the upper lip, jawline and area under the chin) before and after intervention: whether it looks younger, has wrinkles, etc.	In comparison with the experimental group and the control group, only the upper lip appeared to look younger after the intervention	7
Kim et al., 2016	Women, N=16, mean age=not reported (38-45 years)	Isometric resistance exercise, 3 sets twice a day for 8 weeks	Mechanical and elastic properties of skin: cutometer	The ability to return to the original position was improved by increasing the elasticity of the skin. No change in viscoelastic properties	3
Hwang UJ et al., 2018	Women, N=50, mean age=40.0±10.0 years (range: 30-63 years)	Facial exercise using the Pao device, 6 days a week for 8 weeks, twice a day	Muscle thickness, cross-sectional area (ultrasound), facial surface distance, surface area, volumes: laser scanning system Wrinkles and jawline sagging: face visual scale	Increased cross-sectional area of the zygomaticus major Increased muscle thickness in the levator labii superioris and orbicularis oris Midfacial surface distance decreased Facial visual scale improved	3
Alam M et al., 2018	Women, N=16, mean age=53.7±5.8 years (range: 40-65 years)	Muscle resistance facial exercise performed every day for 8 weeks, and facial exercises performed every other day for 9 to 20 weeks	Facial aging: Merz-Carruthers Facial Aging photoscales	Reported satisfaction with all aspects of facial aging after the intervention (showed an increase in upper and lower cheek fullness)	2
Ibrahim F et al., 2013	Women, N=13, mean age=44.7±3.4 years (range: 40 years and above)	Orofacial myofunctional exercise (using Patakara, an oral rehabilitation device) for 14 or 24 weeks, 4 times daily for 3 minutes	Lip De Cum ®/ LDC-110: labial closure strength (LCS), tongue elevation strength (TES) Skin elasticity: cutometer	After the intervention, there were significant improvements in LCS, TES, and skin elasticity	3
Ohtsuka M et al., 2015	Healthy volunteers (but with lip incompetence), N=18, mean age=25.0±2.5 years	Lip endurance training was conducted daily for 4 weeks using 20 repetitions using 50% of orbicularis oris 1RM	Sealed lip ratio: lip-contact sensor and electrical recording device Orbicularis oris endurance: the time from the start of the test to the plates escaping the mouth was recorded as a measure of the endurance of the orbicularis oris	Lip-endurance training increased orbicularis oris endurance and the sealed lip ratio	3
Potter NL et al., 2015	N=33 (16 experimental and 16 control, 1 with Bell's palsy), mean age of experimental group=28.7±17.4 years (range: 18-27 years), and mean age of control group=28.9±16.6 years	Comparison of differences in strength and endurance of lips, cheeks, and tongue between adult trumpet players and non-trumpet players practicing at least 6 hr/wk	Strength and endurance of lip, cheek, and tongue muscles: Iowa Oral Performance Instrument	The trumpet players had greater cheek strength and greater lip endurance than controls. There was no difference in tone strength and endurance	4
Kaede K et al., 2015	N=20 (10 experimental and 10 control), mean age of experimental group=28.5±1.5 years, and mean age of control group=26.7±1.8 years	Lip-closing training (using Patakara). 3 tasks per day for 4 weeks	Multidirectional lip-closing forces (MLCF): MLCF measurement system	The lip-closing force significantly increased in the experimental group in the upward and downward directions compared to the control group	4
Fujiwara A et al., 2016	Women, N=66 (32 group A and 34 group B). Mean age of group A=20.5 years, and mean age of group B=20.2 years)	Intervention (lip training) 2 sets daily for 7 days	Lip-closing force (LCF): multidirectional LCF measurement device	LCP increased in the following order: pre-training, 5 days post-training, and 7 days post-training in every direction	4

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Table 1. Continued

Author, Year	Participants	Intervention	Outcome measures	Salient findings	PEDro score
Yoshizawa S et al., 2016	Healthy volunteers, N=20, mean age=23.6±2.3 years	Hypoxic lip training performed daily for 4 weeks	Sealed lip ratio: lip contact sensor and electrical recording device The tensile strength of the orbicularis oris: measured at the force required for the plate to come out of the oral vestibule	The sealed lip ratios in both the relaxation and concentration conditions significantly increased during the training period	3
Takamoto K et al., 2018	Elderly people, N=20 (10 experimental and 10 control), mean age of experimental group=87.3±1.6 years, and mean age of control group=85.3±5.9 years	Performed lip closure training using an oral rehabilitation device 3 times daily for 4 weeks	Maximal lip closure force: A digital measurement device (Lip De Cum®), eating behavior: digital video cameras, rest-activity rhythm: three-axis accelerometer, cerebral hemodynamic activity during the lip closure movement: near-infrared spectroscopy	The experimental group showed improvement in maximal lip closure force, shortened eating time, decreased food spill rates, and decreased daytime sleeping. The experimental group also showed a significant increase in prefrontal cortical activity during lip closure	7

leading to improvements in facial tone, firmness, and lift.

In this review, most of the positive results (labial closure strength, tongue elevation strength) were confirmed by investigating the effects of exercises around the mouth on orofacial function.[12,21-26] In the facial region, tissue loss contributes little to the severity of wrinkles, but promotes the development of evenly distributed wrinkles.[28] The effects of aging-related tissue loss may play an important role in the transition from dynamic to static wrinkles.[28] The facial muscles are also skeletal muscles and show changes similar to those of the skeletal muscles of the limbs and trunk.[29,30] The mass of facial muscles can also increase through exercise, as is the case for muscles in the extremities.[14,15] Therefore, it is thought that the lip closure force, cheek muscle strength, and lip endurance were improved by increasing the corresponding muscle mass through exercises around the mouth.

Younger skin also has a natural pretension/residual stress on the epidermis that inhibits wrinkle formation.[31,32] However, in this review, the average age in most of the studies for rejuvenation was relatively young (under 50 years old) and most of the participants in the orofacial myofunctional study were young healthy people in their 20 seconds. Therefore, in future research, it will be necessary to investigate changes in muscle mass, skin elasticity, and muscle strength and function, by applying facial exercise to aging skin. Orofacial myofunctional exercise can have effects beyond improving lip closure strength, tongue elevation strength, and skin elasticity. Lip closure dysfunction is one of peripheral causes of obstructive sleep apnea. A study on brain morphology in patients with obstructive sleep apnea revealed atrophy in regions including the frontal lobe.[33] Takamoto et al.[26] reported that lip closure training could improve lip closure dysfunction, improve sleep apnea, and reduce daytime sleep through activation of the brain, including the prefrontal cortex.

Facial muscle exercises, including repeated folding of the facial skin, may induce or aggravate wrinkles rather than reduce wrinkle formation.[34] Most of the interventions aiming at rejuvenation and facial muscle strengthening in this review consisted of isometric exercises (the Pao and Patakara device, manual resistance, etc.). These exercises may make it possible to minimize wrinkles on the face skin, suppress the formation of wrinkles, and effectively strengthen muscles.

In the quality assessment of the included studies, the PEDro score was between 2 and 7 (out of 10), with a median value of 3.5. Two articles showed good quality, but the overall quality was poor. Of the 11 articles, only five articles used a control group, and blinding of subjects and therapists was not performed in any articles. Therefore, in future research, it

will be necessary to investigate the effects of facial exercise in a thoroughly controlled experiment with a sufficient sample size to obtain a higher level of evidence.

In summary, four out of the 11 studies included in this analysis investigated the effects of facial exercises on facial rejuvenation and reported an increase in the thickness and cross-sectional area of facial muscles and an increase in skin elasticity. The remaining seven studies found that facial exercise had meaningful effects on strengthening facial muscles, especially those muscles around the mouth (e.g., the orbicularis oris). Therefore, in future research, it is necessary to study the effects of muscle strengthening on facial rejuvenation by applying facial exercises to muscles other than around the mouth.

A limitation of this review is that it was only conducted using three databases, which do not include the entirety of published research. However, research on facial movement is in its early stages compared to other research fields, and these databases are the most relevant. Furthermore, since the author alone conducted this review, selection bias in the retrieval of studies from the databases could not be eliminated.

This review found data showing that facial exercise has positive effects on facial rejuvenation and facial muscle strengthening, but overall, the level of evidence was quite low. However, some authors have stated that enhancements of facial muscle strength through facial exercise show a high correlation with muscle mass and youthfulness of the face. Future high-quality evidence studies to support these claims will greatly contribute to the development of cosmetology.

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