REVIEW PAPER

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Exercises in the management of forward head posture: much needed posture care for online way of life

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Abstract

Introduction. Forward head posture is a common postural deviation in people of all ages; however, the new online way of life could accentuate this disorder. It involves hyperextension of upper cervical vertebrae (C1–C3) and flexion of lower cervical vertebrae (C4–C7). The aim of the study was to examine the effect of different exercises on forward head posture.
Methods. The electronic databases of PubMed and Cochrane Library (Embase, ClinicalTrials.gov, and International Clinical Trials Registry Platform) were comprehensively searched for randomized controlled trials or clinical trials that investigated different exercises for forward head posture published between January 1, 2010 and March 31, 2020. The studies had to examine at least 1 of the following outcomes: pain, forward head posture parameters, Neck Disability Index, balance, and cervical position sense. PEDro score was used to assess the methodological quality of these studies.
Results. Overall, 19 studies were found that met the inclusion and exclusion criteria. On assessing by PEDro scale, the methodological quality of the studies was 7/10.
Conclusions. Stabilizing exercises and posture correction exercises are effective for the management of forward head posture. Adding manual therapy with these exercises could also be an effective way to treat forward head posture.
Key words: forward head posture, exercises, stabilization exercises, posture correction

Introduction

There can be many reasons that lead to an incorrect shape of muscular and skeletal structures. Most commonly, they include abnormal postures with physical activity reduction, as well as inappropriate or awkward postural habits with long-term use of smartphones and computers. There is a rapid surge in online activities, involving increased use of digital screens for all types of services owing to the COVID-19 pandemic. It has led to sitting in awkward and ergonomically incorrect postures for a prolonged time, which causes various postural problems even in healthy or asymptomatic individuals. One of the abnormal postures is forward head posture (FHP). It is termed as excessive anterior positioning of head in relation to the vertical reference line [1]. It is associated with lower cervical spine flexion, middle cervical spine extension, atlanto-occipital joint extension, and increased lower cervical spine lordosis [2–3].

Craniovertebral angle (CVA) measurement is the most commonly used method for FHP quantification [4]. CVA is formed between the line joining C7 to tragus and the horizontal line extending from C7. When CVA is equal to or less than 50°, it is characterized as pathological [5]. Most often, deep neck flexor and neck extensor muscles provide stability to the cervical spine. Deep neck flexors are the longus colli and capitis that supports the cervical lordotic curve. Rectus capitis posterior major, rectus capitis posterior minor, and oblique capitis superior and inferior are suboccipital muscles that constitute chief neck extensors of the upper cervical spine [6].

FHP is usually more frequently observed in subjects who have any other abnormal posture condition. Diab [7] stated that in patients with scoliosis, the risk of FHP occurrence was higher as compared with normal individuals. Similarly, Lee et al. [8] established that increasing usage of electronic screens such as smartphones and personal computers for an average of 8 hours per day increased the probability of having FHP. Also, greater FHP is associated with decreased cervical range of motion, particularly neck flexion and rotation [9, 10]. Predictive factors for cervical pain include decreased CVA and decreased flexion range of cervical spine [11]. In subjects with smaller CVA, there is a higher risk of occurrence of tension type headache [12]. Respiratory function, balance, and neck proprioceptive function are also influenced by FHP [4, 13, 14]. With regard to balance, static balance control is more affected by FHP than dynamic balance control [3]. Since this condition is becoming a result of the current lifestyle that is being adopted owing to increased sedentary routines and constant use of devices for personal and professional responsibilities, through this review, we aimed to investigate the types of exercises that could be effectively applied to treat FHP without the need to administer medications or any advanced medical procedures.

Subjects and methods

Literature search strategy

The electronic databases of PubMed and Cochrane Library (Embase, ClinicalTrials.gov, and International Clinical Trials Registry Platform [ICTRP]) were searched on March 31, 2020. The search strategy consisted of all field/text terms, filtered for title and abstract for the following keywords in their combinations: “exercises”, “forward head posture”, “neck pain”, and “Pilates treatment”. The references of the selected articles were further searched for additional related studies.

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Selection criteria

The electronic database search retrieved 316 articles (PubMed advanced: 183, ICTRP: 46, Embase: 38, Cochrane: 31, ClinicalTrials.gov: 18). After removing duplicates from different databases, the final number was 297.

The studies were selected by screening the titles and abstracts by one of the authors of the review; this was checked by subsequent authors. Only randomized controlled trials and clinical trials published between January 1, 2010 and March 31, 2020 were selected. All potential studies were retrieved and the full-text articles were investigated to determine whether they met the inclusion criteria. The inclusion criteria were as follows: a randomized controlled trial or clinical trial, total number of participants equal to or greater than 25, only full-text articles, a minimum PEDro score of 5, outcomes containing at least 1 of the subsequent aspects: pain, FHP parameters, Neck Disability Index (NDI), balance, cervical position sense. Studies were excluded if they were not available in the English language, if they examined effects of exercise on outcomes in specific patients like stroke survivals or after surgery, if they were articles published as case studies, pilot studies, editorials, expert opinions, or instructive papers.

Data extraction

Review authors BC, SJ, and AP extracted study data on the following topics: first author's name, date of publication and country, quality assessment of the study, participants' characteristics (like sample size, age, and sex), intervention type and duration, outcomes, evaluation and follow-up timing, and conclusions.

Article quality assessment

The nature of all data was resolved by utilizing the PEDro scale for randomized controlled trials (Table 1) [33]. The PEDro tool has a maximum possible score of 10, focusing on 11 criteria. It involves eligibility criteria but this was not used for scoring because it impacts on the external validity of a study, not on statistical or internal validity. The studies with scores of 9–10 were considered methodologically 'excellent,' 6–8 were considered 'good,' 4–5 were considered 'fair,' and < 4 were considered 'poor'. Articles were independently assessed by all the authors. Scoring inconsistencies were discussed and re-evaluated by all authors in the selected articles. Finally, 19 studies met the eligibility criteria. Of these 19 studies, 1 study had an 'excellent' score, while 15 studies had a 'good' score, and 3 had a 'fair' score as assessed by PEDro scale; the methodological quality of the studies was 7/10. Figure 1 shows the study flow diagram for the included studies.

Results

Study selection

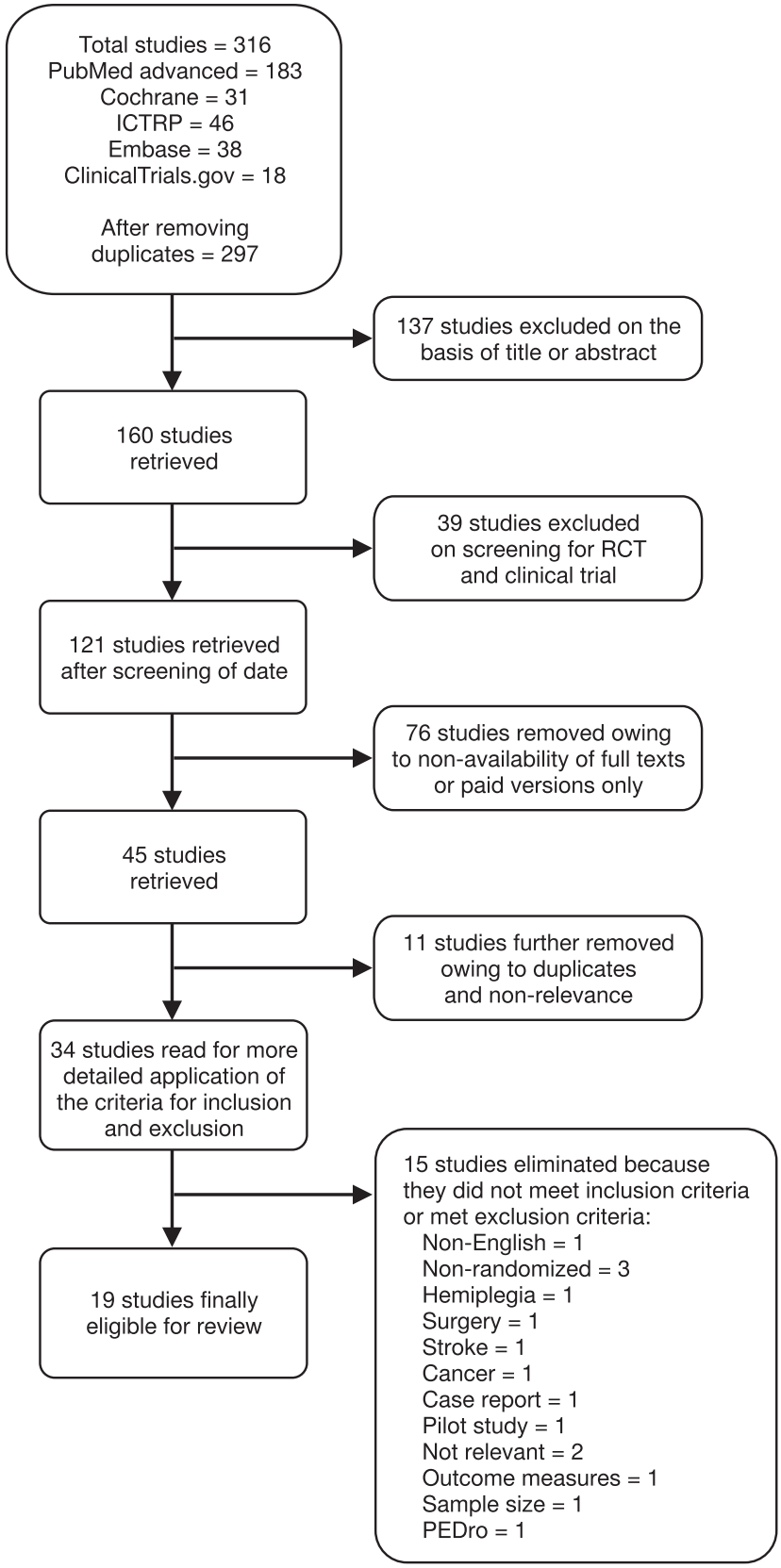
The electronic database search retrieved 316 articles (PubMed advanced: 183, ICTRP: 46, Embase: 38, Cochrane: 31, ClinicalTrials.gov: 18). After removing duplicates from different databases, the final number was 297. After screen-

Table 1. PEDro scoring for the included studies

No.	Authors, year	1	2	3	4	5	6	7	8	9	10	Total
1.	Fathollahnejad et al., 2019 [15]	Y	Y	Y	Y	N	Y	Y	N	Y	Y	8
2.	Ruivo et al., 2017 [16]	Y	Y	Y	Y	N	Y	Y	N	Y	Y	8
3.	Shih et al., 2017 [17]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	9
4.	Cho et al., 2017 [18]	Y	N	Y	N	N	Y	Y	N	Y	Y	6
5.	Shiravi et al., 2019 [19]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7
6.	Ruivo et al., 2016 [20]	Y	Y	Y	Y	N	Y	Y	N	Y	Y	8
7.	Cho et al., 2019 [21]	Y	N	Y	N	N	Y	Y	N	Y	Y	6
8.	López-de-Uralde-Villanueva et al., 2018 [22]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
9.	Diab, 2012 [23]	Y	Y	Y	N	N	N	Y	Y	Y	Y	7
10.	Balbás-Álvarez et al., 2018 [24]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7
11.	Diab and Moustafa, 2012 [25]	Y	N	Y	N	N	N	Y	N	Y	Y	5
12.	Letafatkar et al., 2020 [26]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
13.	Lee and Lee, 2019 [27]	Y	N	Y	N	N	Y	Y	Y	Y	Y	7
14.	Goosheh et al., 2019 [28]	Y	N	Y	N	Y	N	Y	Y	Y	Y	7
15.	Lynch et al., 2010 [29]	Y	N	Y	N	N	N	Y	N	Y	Y	5
16.	Jeong et al., 2018 [6]	Y	N	Y	Y	Y	N	Y	N	Y	Y	7
17.	Kim and Kim, 2019 [30]	Y	N	Y	N	N	N	Y	N	Y	Y	5
18.	Uluğ et al., 2018 [31]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7
19.	De Araujo Cazotti et al., 2018 [32]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8

Y – yes, N – no

ing the title and abstract, 160 studies were retrieved. Then, we narrowed down the electronic search to randomized controlled trials from years 2010–2020 and full texts. Two reviewers independently reviewed the remaining articles. A total of 45 studies were found. Out of these, 11 studies either were found duplicate or did not fit the inclusion/exclusion criteria. Therefore, 34 studies were left. A final detailed rechecking of the studies led to exclusion of 15 more studies, as shown in Figure 1. Finally, 19 studies were included in the review (Table 2).



ICTRP – International Clinical Trials Registry Platform, RCT – randomized controlled trial
Figure 1. Study flow diagram

Table 2. Brief description of the included studies

No.	Authors, year, country	Study type	Sample size (age, years)	Intervention groups	Outcomes	Intervention duration (evaluation and follow-up)	Conclusions	Significance (p) of between-group difference
1.	Fathollahnejad et al., 2019, Iran [15]	RCT	60 women with neck pain and FHRSP (32–42), 20 per group	Group 1: MT + stabilizing exercises (MT: 10 min, 3 sessions/week) Group 2: stabilizing exercises (10–15 repetitions, 3 sets, 3 sessions/week) Group 3: home exercises (3 sessions/week) All for 6 weeks	– Pain (VAS) – Functional endurance – FHA – FSA	6 weeks (0, 6 weeks; F: 1 month)	Significant improvement was seen in pain, functional endurance, and posture in group 1 and 2; more improvement was observed in group 1 in comparison with group 2. All outcomes were maintained after 1-month follow-up in group 1	– Pain: 0.012 – Function: 0.009 – Head posture: 0.016 – Shoulder posture: 0.018
2.	Ruivo et al., 2017, Portugal [16]	RCT	130 adolescents with FHP and PSP (15–17) Intervention group: 84 Control group: 46	Intervention group: PE classes + posture corrective program (4 strengthening and 3 stretching exercises), 2 sessions/week for 16 weeks Control group: PE classes	– Sagittal head angle – CA – Shoulder angle – Neck and shoulder pain, function (ASES score)	16 weeks (0, 16 weeks)	Cervical and shoulder angles significantly improved in intervention group, with no significant changes in ASES score	– Sagittal head tilt angle: 0.265 – CA: 0.006 – Shoulder angle: 0.046 – ASES (right): 0.651 – ASES (left): 0.852
3.	Shih et al., 2017, Taiwan [17]	RCT	60 subjects with FHP (< 20) W: 31 M: 29 20 per group	Kinesio taping group: 2 sessions/week for 5 weeks Exercise group: 30 min/session, 2 sessions/week for 5 weeks Control group: posture education program	– HFD – Upper and lower CA – AROM – NDI	5 weeks (0, 5 weeks; F: 2 weeks)	Both Kinesio taping and exercise group showed significant improvement in HFD and lower CA after treatment and in HFD at 2-week follow-up. Exercise group showed more improvement in side bending AROM and rotation after treatment and overall exercise was better than Kinesio taping	–
4.	Cho et al., 2017, South Korea [18]	RCT	32 subjects with FHP (20–29) Cervical group: 16 Thoracic group: 16	Group A: mobilization of upper cervical vertebrae + retraction exercise of cervical area Group B: mobilization of upper thoracic vertebrae + extension exercise of upper thoracic area Exercises: 10 repetitions/set, total 3 sets	– CVA – CROM – NPRS – NDI – PPT – GRC	4 weeks (0, 4 weeks; F: 2 weeks)	Thoracic group showed more significant improvement in CVA (standing), extension range of motion, NPRS, NDI, GRC in comparison with group A	– CVA (sitting): 0.536, 0.252* – CVA (standing): 0.008, 0.042* – NPRS: < 0.001, 0.002* – PPT: 0.251, 0.251* – NDI: 0.006, 0.008* – Cervical flexion: 0.428, 0.104* – Cervical extension: 0.108, 0.016* – Lateral flexion (right): 0.515, 0.833* – Lateral flexion (left): 0.033, 0.051* – Rotation (right): 0.088, 0.797* – Rotation (left): 0.054, 0.054*

5.	Shiravi et al., 2019, Italy [19]	RCT	135 women with FHRSP (20–30), 45 per group	Group 1: ACF with SSE Group 2: SSE without ACF Group 3: control group (active self-exercise), 30 min/day, 3 sessions/week For 6 weeks in all groups	– Pain – Strength – Electromyography – Shoulder proprioception	6 weeks (0, 8 weeks)	SSE with ACF had more significant impact on all variables as compared with SSE alone	Groups 1 and 3: – VAS: 0.004 – Proprioception: 0.002 – Strength of UT: 0.501, MT: 0.516, LT: 0.750, SA: 0.154 Groups 2 and 3: – VAS: 0.001 – Proprioception: 0.001 – Strength of UT: 0.387, MT: 0.424, LT: 0.793, SA: 0.397 Groups 1 and 2: – VAS: 0.036 – Proprioception: 0.034 – Strength of UT: 0.835, MT: 0.881, LT: 0.564, SA: 0.564
6.	Ruivo et al., 2016, Portugal [20]	RCT	130 adolescents with FHP and PSP (15–17) Group 1: 42 (M: 15, W: 27) Group 2: 46 (M: 14, W: 32) Group 3: 42 (for longitudinal study)	Exercise group: posture corrective exercise + PE classes (2 sets of 15 repetitions, 2 sessions/week) Control group: PE classes	– Sagittal head angle – CA – Shoulder angle – Shoulder pain, function, and neck pain (ASES)	32 weeks (0, 32 weeks; detraining period: 16 weeks)	Cervical and shoulder angles were significantly increased in exercise group (within-group) after 2 weeks, with no significant differentiation in sagittal head, cervical or shoulder angles in exercise group after detraining period	– HT angle: 0.12 – CA: 0.17 – SA: 0.022
7.	Cho et al., 2019, Korea [21]	RCT	31 subjects with FHP (20–29) Mobilization group: 15 Exercise group: 16	Mobilization group: upper cervical and thoracic (less than 10 min with 10-s break) Exercise group: deep cervical flexor exercise (10 repetitions/set, 3 sets with 10-s hold)	– CVA – Pain – Respiratory function – GRC	4 weeks (0, 4 weeks; F: 2 weeks)	Pain, CVA, and respiratory parameters were significantly more improved in mobilization group compared with exercise group	– CVA: 0.013, 0.041* – NPRS: 0.001, 0.004* – FVC: 0.019, 0.045* – FEV1: 0.036, 0.0.014* – PIP: 0.003, 0.359* – PIF: 0.020, 0.074* – PIV: 0.015, 0.093*
8.	López-de-Uralde-Villanueva et al., 2018, Spain [22]	RCT	43 patients with asthma (18–60) Group 1: 21 Group 2: 22	Group 1: IMT (20 min) Group 2: IMT (20 min) + MT (15 min) + therapeutic exercise (15 min) Total: 12 sessions (2 days/week for 6 weeks)	– MIP – spirometric measures – FHP – TK	6 weeks (0, 6 weeks)	MIP and FHP was improved more at short term in group 2 as compared with group 1 but neither protocol was effective in decreasing TK and no difference was found in spirometric measures	–
9.	Diab, 2012, Egypt [23]	RCT	76 adolescent idiopathic scoliotic patients Study group: 38 Control group: 38	Experimental group: strengthening and stretching exercises (3 times/week) + FHP corrective exercises (12 repetitions/set, 3 sets, 4 times/week) for 10 weeks Control group: strengthening and stretching exercises (3 times/week) for 10 weeks	– CVA – Functional rating index – Postural parameters	10 weeks (0, 10 weeks; F: 3 months)	CVA and postural parameters were significantly improved in experimental group as compared with control group and these significant changes were maintained after 3 months. Functional status was equally improved in both groups after 10 weeks and after 3-month follow-up, significant decline in functional index were seen in control group	– CVA: 0.006, 0.002* – Trunk inclination: 0.005, 0.02* – TK: 0.001, 0.004* – Lumbar lordosis: 0.01, 0.017* – Trunk imbalance: 0.001, 0.000* – Lateral deviation: 0.001, 0.0.002 – Pelvic torsion: 0.004, 0.000* – Surface rotation: 0.013, 0.001* – Functional index: 0.8, 0.001*

10.	Balbás-Álvarez et al., 2018, Spain [24]	RCT	51 healthy moderate smokers (18–60) IMT group: 25 Combined intervention group: 26	IMT group: 30 min, 2 days/week for 4 weeks Combined intervention group: IMT (30 min) + MT (thorax and cervical area) + motor control exercise (20–30 min, 4 days/week)	– MIP – FHP – TK – Pulmonary function	4 weeks (0, 4 weeks)	MIP, FHP, and TK except lung function were significantly improved in combined intervention group and only MIP was also significantly improved in IMT group	–
11.	Diab and Moustafa, 2012, Egypt [25]	RCT	96 patients with unilateral lower cervical spondylotic radiculopathy Exercise group: 48 Control group: 48	Exercise groups: strengthening and stretching exercises (12 repetitions/set, 3 sets, 30-s hold, 4 times/week for 10 weeks) + infrared radiation + ultrasound Control group: infrared radiation (10 min) + ultrasound (10 min, intensity: 1.5 W/cm^2, 3 times/week for 10 weeks)	– CVA – Pain (VAS) – Peak-to-peak amplitude of dermatomal somatosensory evoked potential	10 weeks (0, 10 weeks; F: 6 months)	CVA, peak-to-peak amplitude of dermatomal somatosensory evoked potential were significantly increased and pain intensity was significantly decreased in exercise group compared with control group and these significant changes were maintained after 6 months	– CVA: 0.000, 0.000* – Pain: 0.01, 0.000* – C6 peak-to-peak amplitude: 0.000, 0.000* – C7 peak-to-peak amplitude: 0.001, 0.000*
12.	Letafatkar et al., 2020, Iran [26]	RCT	48 female dentists (40–45) Experimental group: 24 Control group: 24	Experimental group: 3 supervised exercises during weeks 1–5, 2 supervised exercise sessions, 1 session home exercise during weeks 6–7, 1 supervised exercise session, and 2 home exercise sessions during week 8 (20–30 min) Control group: postural corrections	– Pain (VAS) – Disability (NDI) – Posture (FHA and PSA) – Health status (self-rated general health questionnaire)	8 weeks (0, 8 weeks)	Pain, disability significantly reduced and posture, health status significantly improved in experimental group	– Pain: 0.003 – Disability: 0.009 – Sagittal head tilt: 0.093 – FHA: 0.039 – PSA: 0.031 – Health status: 0.022
13.	Lee and Lee, 2019, Korea [27]	RCT	62 patients with tension type headache (19–29) M: 26 W: 36 Biofeedback group: 21 MT group: 20 Stretching group: 21	Biofeedback group: 22–30 mm Hg, 15–20 repetitions/set, 3 sets, 3 times/week for 4 weeks MT group: C0–C2, C7, craniocervical muscle, each 15 min, 3 times/week for 4 weeks Stretching group: chest and neck muscles (6 methods), 10 s, 10 sets, 3 times/week for 4 weeks	– CVA – Attention – Stress (heart rate, skin conductance, skin temperature, respiratory rate) – PPT – Impact of headache on ADL – Quality of life	4 weeks (0, 4 weeks; F: 2 weeks)	Biofeedback was more effective than MT and stretching in treatment of tension type headache due to FHP	–
14.	Goosheh et al., 2019, Iran [28]	RCT	46 subjects with FHP (18–40) Chin tuck group: 23 Turtle group: 23	Chin tuck exercise: 10 times, 10-s hold, 3 times/week for 6 weeks Turtle exercise: 10 times, 3 times/week for 6 weeks	– Cervical curve	6 weeks (0, 6 weeks)	Cervical curve decreased significantly in both groups but both groups showed the same immediate effect	– Cervical curve: 0.54
15.	Lynch et al., 2010, USA [29]	RCT	28 swimmers (17–23) Exercise group: 14 Control group: 14	Exercise group: strengthening and stretching exercises, 10 repetitions/set, 3 sets, 3 times/week for 8 weeks	– FHP and RSP – Strength – Shoulder pain – Function	8 weeks (0, 8 weeks)	Exercise group showed significant improvement in FHP, RSP, and strength but not in ASES score	– FHA: 0.005 – FST: 0.001 – ASES: 0.389

16.	Jeong et al., 2018, Korea [6]	RCT	20 subjects with neck pain SMI group: 10 CCFE group: 10	CCFE group: deep neck flexors exercise with feedback SMI group: pressure maintained for 4 min between C2 and occipital condyles	– SLR – PA – CVA – CROM	Immediate effect	All variables were significantly improved in both groups and similarly improved variables were SLR (left), PA, CVA (standing)	– CVA (sitting): 0.02 – CVA (standing): 0.97 – Cervical flexion: 0.32 – Cervical extension: 0.77 – Cervical lateral flexion (left): 0.20 – Cervical lateral flexion (right): 0.46 – Cervical rotation (left): 0.63 – Cervical rotation (right): 0.46 – SLR (left): 0.98 – SLR (right): 0.05 – PA (left): 0.40 – PA (right): 0.08
17.	Kim and Kim, 2019, Korea [30]	RCT	30 subjects Experimental group: 15 Control group: 15	Experimental group: Bodyblade exercise + physiotherapy, 1 session, 4 sets, 3 sessions/week for 6 weeks Control group: physiotherapy treatment, 20 min Hot pack, 15 min TENS, 5 min ultrasound therapy	– CVA – CRA – Plantar pressure	6 weeks (0, 6 weeks)	Experimental group showed significant improvement in CVA, CRA, plantar pressure; control group showed significant improvement only in CVA	– CVA: 0.01 – CRA: 0.01 – Anterior pressure: 0.03 – Posterior pressure: 0.02 – Left pressure: 0.99 – Right pressure: 0.99
18.	Uluğ et al., 2018, Turkey [31]	RCT	56 patients with chronic pain (18–50) Pilates group: 20 Yoga group: 18 Isometric group: 18	Pilates group: 10 repetitions/set, 2 sets/day for 6 weeks Yoga group: 10 repetitions/set, 2 sets/day for 6 weeks Isometric group: 30 repetitions/set, 2 sets/day All exercises and yoga for 6 weeks All groups received Hot pack, ultrasound, TENS in addition to exercises for 3 weeks (5 days/week)	– Thickness and cross-sectional area of muscle – Cervical motion – Pain – Disability – Quality of life – Emotional status	6 weeks (0, 6 weeks)	Favourable impact on all variables observed in all groups, only thickness of semispinalis capitis was increased in Pilates group and all variables presented no differences between all groups	– Pain, quality of life, depression, disability: < 0.005 – Thickness of semispinalis capitis: 0.022
19.	De Araujo Cazotti et al., 2018, Brazil [32]	RCT	64 patients with chronic mechanical neck pain (18–65) Pilates group: 32 Control group: 32	Pilates group: 6–12 repetitions/set, 1 set/day, 2 days/week for 12 weeks + acetaminophen Control group: 750 mg acetaminophen after every 6 hours when experienced pain	– Pain – Disability – Quality of life	12 weeks (0, 45, 90, 180 days)	Pilates group showed significantly more improvement in all variables	– Pain: < 0.001 – Function: < 0.001 SF-36: – Functional capacity: 0.19 – General health: 0.022 – Pain: < 0.001 – Vitality: < 0.001 – Mental health: 0.12

ADL – activities of daily living, AROM – active range of motion, ASES – American Shoulder and Elbow Surgeons shoulder assessment, CA – cervical angle, CCFE – craniocervical flexion exercise, CRA – cranial rotation angle, CROM – cervical range of motion, CVA – craniovertebral angle, F – follow-up, FEV1 – forced expiratory volume in 1 second, FHA – forward head angle, FHP – forward head posture, FHRSP – forward head and rounded shoulder posture, FSA – forward shoulder angle, FST – forward shoulder translation, FVC – forced vital capacity, GRC – global rating of change, HFD – horizontal forward displacement, HT – head tilt, IMT – inspiratory muscle training, LT – lower translation, M – men, MIP – maximum inspiratory pressure, MT – manual therapy, NDI – Neck Disability Index, NPRS – Numeric Pain Rating Scale, PA – popliteal angle, PE – physical education, PIF – peak inspiratory flow, PIP – peak inspiratory pressure, PIV – peak inspiratory volume, PPT – pressure pain threshold, PSA – protracted shoulder angle, PSP – protracted shoulder posture, RCT – randomized controlled trial, RSP – rounded shoulder posture, SA – shoulder angle, SF-36 – 36-item Short Form Health Survey, SLR – straight leg raise, SMI – suboccipital muscle inhibition technique, SSE – scapular stabilization exercise, TENS – transcutaneous electrical nerve stimulation, TK – thoracic kyphosis, UT – upper trapezius, VAS – visual analogue scale, W – women
* follow-up values

Study characteristics

The final 19 studies included 1180 individuals, out of which 1054 were in the age range of 15–65 years; 4 studies did not specify any age group. The duration of interventions ranged from immediate effect to 32 weeks, with 2–4 sessions per week. CVA, sagittal head angle, cervical angle, forward head angle, horizontal forward displacement, upper cervical angle, lower cervical angle, cervical curve, cranial rotation angle (CRA), and cervical range of motion were parameters assumed to analyse FHP. Cervical pain was assessed by visual analogue scale (VAS), Numeric Pain Rating Scale (NPRS), and McGill pain scale in 8 studies. Function and disability were evaluated with NDI in 5 studies. Balance was measured by plantar pressure in 1 study.

Description of selected variables

Criteria to define variables

CVA: 5 studies did not specify the criteria to diagnose FHP [6, 22, 24, 25, 28]. Various studies used different criteria for evaluating FHP, like CVA greater than 46° [15, 19], less than 49° [18, 27], less than 50° [16, 20, 21, 23, 26], and less than 52° [30]. In some other studies, the horizontal distance between the ear lobe and acromion process was applied, which should be less than 3.5 cm [17], and in another one, the criterion was that the lateral acromion process and external auditory meatus should be anterior to the vertical line that intersects the lateral malleolus [29].

Pain and disability: 3 studies used VAS (3–8) [15, 19, 26], while 2 studies employed NPRS (3–8 [32], 3–6 [6]) for pain assessment. One study included only mechanical neck pain [21], while another one utilized neck pain that was located specifically in the region between the posterior part of cervical spine to interscapular area [18]. One study applied the duration of radiculopathy symptoms exceeding 3 months [25] in the inclusion criteria, whereas 2 studies demanded neck pain lasting for at least 3 months [31, 32]. In 2 studies, NDI ranging 0–5 was used [6, 17], and 1 applied NDI ranging 3–8 [26] as an inclusion criterion.

Measurement of variables

FHP: Some variations were found in the analysed studies for the methods used in FHP calculation. Overall, 12 studies applied the photogrammetry method, while others utilized the BioPrint postural analysis system [15], inclinometer [29], horizontal ruler bar [28], or a cervical range of motion device [22, 24]. CVA was defined as the angle between the line connecting the tragus and C7 and the vertical line passing through C7, or the angle formed between the line joining the tragus and C7 and the horizontal line extending from C7. CVA was also referred to as cervical and forward head angle in literature. Sagittal head angle was defined as the angle between the horizontal line extending from the tragus and the line connecting the tragus and the lateral canthus of ear. It was also referred to as cranial rotational angle. Horizontal forward displacement was measured between the ear lobe and the acromion process. Upper cervical angle was measured as the angle formed between the line from forehead to the ear lobe and the line from T1 to the ear lobe. Lower cervical angle was determined as the angle formed between the vertical line and T1 to ear lobe line. As the upper cervical angle increases, extension increases in the upper cervical spine. As the lower cervical angle increases, flexion increases in the lower cervical spine. Decreased CVA and increased CRA represent FHP.

Other variables: 4 studies used VAS [15, 19, 25, 26], 3 studies applied NPRS [18, 21, 32], 1 study utilized McGill pain scale [31] for pain. A total of 5 studies used NDI for disability [17, 18, 26, 31, 32]. One study applied the Gaitview AFA-50 (resistance type, pressure sensor measurement device) for evaluating plantar pressure distribution, used to assess balance [30].

Interventions

All studies included exercises with or without other interventions. Exercises administered in these studies were stabilizing exercises, posture correction exercises, low load training exercises, deep cervical flexor exercises, motor control exercises, strengthening and stretching exercises, biofeedback exercises, turtle exercises, craniocervical flexion exercises, Bodyblade exercises, Pilates, a home exercise program. Stabilizing exercises included 'Y to W,' 'L to Y,' scapular protraction, pectoralis stretching, and chin tuck. Posture correction exercises included side lying external rotation, prone horizontal abduction with external rotation, 'Y to I' exercise, chin tuck, unilateral self-stretch exercise of pectorals minor, static sternocleidomastoid and levator scapulae stretch. Low load training exercises involved resisted and isometric chin tuck in sitting, upper trunk extension with chin tuck in prone. Scapula stabilization exercises included chin tuck, overhead press horizontal pull apart, chest press, serratus anterior punches, retraction plus external rotation, scapular protraction, 'XY,' and 'TYW' exercises. Strengthening and stretching exercises involved strengthening of shoulder retractors and deep cervical flexors, stretching of pectoral muscles and cervical extensors.

Discussion

The purpose of the present study was to systematically review the published studies conducted on FHP and neck pain. A total of 19 studies were included in this review that trailed different types of exercise with different intensities and measured a variety of physiological functions. Most commonly, these studies examined subjects aged over 15 years with FHP and rounded shoulder posture. Age was not clearly mentioned in some papers [6, 23, 25, 30]. Spine surgery, fractures, and malignancy were most often involved as exclusion criteria. In 3 studies, exercises were completely supervised by a therapist [15, 16, 20]. Exercises were partially supervised in 5 studies and other studies did not clearly mention if exercises were supervised or not. There are numerous methods for assessing FHP; however, this review suggests that the photogrammetric method and CVA measurement may be the most favoured because it was used in most randomized controlled trials and clinical trials with high reliability and validity. Some articles also presented improvements after the training period. A study of 2016 showed improvement in sagittal head and shoulder angles but it was not significant after the detraining period of 16 weeks following the interventions of 32 weeks [20]. In another study, performed in Taiwan, improvement in horizontal forward displacement was maintained at a 2-week follow-up period [17].

Exercises alone when used as a treatment method in some evidence-based studies produced significant improvement in FHP symptoms. The exercise types that showed good results for FHP and neck pain were mainly stabilization exercises and posture correction exercises like chin tuck, pectoralis

stretching, 'Y to W,' 'L to Y,' sternocleidomastoid and levator scapulae stretching.

Biofeedback used as one of the physiotherapy treatments with exercises provided better results, as supported in 7 trials. Out of these, 4 studies showed that biofeedback was an important method to improve the strength of muscles, joint proprioception, cervical range of motion, pain, and posture in patients. When it was placed under the cervical area, exercises of deep neck flexors of upper cervical area occurred rather than of superficial neck flexor muscles and it stretched the principle neck extensor muscles of upper cervical spine, resulting in reduced tone of myodural bridge and hamstring muscles [6]. Abdominal feedback was used in an Italian study in which stabilization exercise with feedback activated the serratus anterior, reducing the activation of upper trapezius and sternocleidomastoid muscle more effectively [19]. In this regard, it improved neck pain and FHP more as compared with stabilization exercises alone. In a study by Cho et al. [21], deep cervical flexors exercise with feedback intervention used in comparison with upper and thoracic mobilization intervention suggested that manual therapy applied to the thoracic and cervical area was more effective than just exercises. Deep cervical flexors exercises are low-intensity isometric exercises for the improvement of cervical instability.

As for electrotherapy, stretching of cervical extensors and pectorals and strengthening of deep cervical flexors, shoulder retractors with 10-minute infrared radiation on neck, and 10-minute ultrasound application with 1.5 W/cm^2 intensity on upper trapezius were more effective in decreasing pain, CVA, and peak-to-peak amplitude of dermatomal somatosensory evoked potential of C6, C7 [25]. A total of 20 minutes of Hot pack, 15 minutes of transcutaneous electrical nerve stimulation, and 5 minutes of ultrasound therapy with Bodyblade exercises were effective in improving CVA, CRA, and plantar pressure [30]. So, physiotherapy modalities and therapy can be used as an adjunct treatment with exercise for FHP in a better way.

Pilates had a favourable impact on semispinalis capitis, which is a long cervico-thoracic muscle and functions as head and neck extensor muscle. By giving stabilization to trunk muscles, Pilates improves the body movement pattern. It helps in increasing nutrition of joints and cartilages. It decreases hypertension in shortened muscles, improves breathing methods and core stability, and increases awareness of postural misalignments. In conclusion, whole body muscle retraining occurs and hence improves CVA. A recent study even reported a decreased diaphragmatic excursion in subjects with FHP with a non-specific chronic neck pain as compared with people with normal head posture [34].

Correction of forward head also helps in the management of scoliosis, lordosis, cervical radiculopathy pain, and their symptoms. In a study by Diab [23], an FHP correction exercise program in addition to traditional treatment showed more improvement in 3 dimensional posture parameters and these significant changes were maintained at 3 months.

This review was an attempt to assess various physiotherapy treatments with exercises in order to find the most effective treatment approach when used together. A unique contribution of the study is that it reviewed the independent effect of forward head correction on long-term neural functions and spinal postures like scoliosis and lordosis.

Limitations

Only studies in the English language were included in the review, and this may have led to missing of papers written in other languages. The search strategy and selection criteria used were quite strict and easy to apply and also followed normal procedures for conducting systematic reviews [35]. We did not assess the risk of bias. Another limitation of the study was not having an upper limit of age for the included participants of the trials; age has an effect on FHP, too, as reported by various studies. Aging itself could be a factor to develop FHP as compared with younger age [36, 37].

Conclusions

This present study shows that stabilizing exercises and posture correction exercises are effective for the management of FHP. These types of exercises include mostly deep cervical flexor strengthening, scapular retractor strengthening, pectoralis stretching, sternocleidomastoid stretching, cervical extensor stretching, 'Y to W' exercises. They can be easily taught and administered to any patient; also, they do not require any special setting or equipment. Therefore, they could be of great help to people leading a sedentary life, especially involving computers or laptops. However, addition of manual therapy to these exercises provided better results. Healthcare professionals should advise on correct posture care and physical therapists play a major role here to administer manual therapy wherever appropriate for treating patients presenting with any musculoskeletal condition, especially in the current situation of long phases of lockdown and less active lifestyle. Literature also agrees on the importance of biofeedback as a crucial method to improve the strength of deep cervical flexor muscles.

Ethical approval

The conducted research is not related to either human or animal use.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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