The effect of nutritional educational programs involving parents on the children dietary behaviour: a systematic review of clinical controlled trails

تأثير البرامج التغذوية المشتملة على الوالدين على سلوك الاطفال التغذوي: مراجعة منهجية للتجارب السريرية المسيطر عليها

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Abstract

Although many efforts have been applied to tackle obesity, it's still on the rise, especially among children. Recently, many nutritional educational programs have been conducted in schools to reduce the prevalence of obesity and overweight. The aim of this systematic review is to investigate how effective these programs on the participants' dietary behavior and how far their effect can prevent childhood obesity and overweight if parents/guardians have been involved. Studies were systematically reviewed after searching the Pubmed, Questia, and Science Direct databases. Twelve relevant studies involving parents, have met the inclusion criteria, 8 of them had available results. The assessed outcomes of the reviewed studies have included: nutritional knowledge, food intake, anthropometric measurements, and physical activity. Half of the reviewed

studies had positive results and the other half has mixed results. However, data showed significant positive improvements in both anthropometric measurements (for girls a significant reduction in the BMI within the interventional group BMI ($p = 0.047$) and physical activity (Interventional group mean of steps =13,681 compared to the control mean = 9619 and the attendance in physical education class had increased as well in both genders as well ($p = 0.003$, $p = 0.002$) in most studies. It was concluded from the reviewed studies that nutritional educational programs can be an effective prevention action against childhood obesity and overweight with emphasis on the parents as a key role. More efforts from researchers, schools, and stakeholders are required to develop and carry these programs on larger scales and inevitably involving the parents.

Keywords: Nutritional Program, Children, Parental Involvement, Education, Obesity, Dietary Behavior.

ملخص

على الرغم من الجهود المبذوله لمعالجه السمنه الا انها بازدياد، خاصه بين الأطفال. حاليا العديد من البرامج التغذويه التعليميه تم اجراؤها في المدارس للتقليل من انتشار السمنه والوزن الزائد. ان هدف هذه المراجعه الممنهجه هو التحري عن مدى فعاليه هذه البرامج والمنطويه على الإباء او المربين للوقايه من السمنه. لقد تم مراجعه الدراسات بعد البحث في المحركات البحثيه التاليه: بوب ميد، كويستيا، سيانس دايريكت. اثنا عشره دراسه منوطيه على الإباء وافقت الخصائص المطلوبه وكان منها ثمان دراسات تحوي على نتائج. لقد تم تقييم مخرجات الأبحاث التاليه: المعرفه التغذويه، الغذاء المتناول، قياسات الجسم، والنشاط البدني. لقد احتوى نصف الدراسات على نتائج ايجابيه والأخر كانت نتائجه مختلطه. وعلى أي حال كانت النتائج ذات فروق معنويه في قياسات الجسم والنشاط البدني في معظم الدراسات. يمكن الاستنتاج من الدراسات التي تم مراجعتها ان البرامج التغذويه يمكن ان تكون فعاله لتجنب السمنه في فتره الطفوله بالتأكيد على دور الإباء كعامل أساسي. يجب بذل المزيد من الجهود من قبل الباحثين وأصحاب القرار على المستوى الاوسع لتطوير هذه البرامج وإدخال الإباء فيها لزياده فعاليتها.

الكلمات المفتاحية: برامج غذائيه، الاطفال، الاباء، تعليم، السمنه، السلوك الغذائي.

Introduction

Childhood obesity is one of the most serious public health problems worldwide. According to the World Health Organization about 41 million

children under 5 years old and 340 million children between the age of 5 to 19 were obese or overweight in 2016 (1). Obesity and overweight are defined as abnormal elevated fat accumulation in the body that may impair health (1). There are many techniques that have been developed to measure body fat. Body Mass Index (BMI) which is an index of weight-for-height, waist circumference, and skin fold thickness are widely used in clinical studies. Obesity and overweight during childhood have many negative effects on both physical and mental health. Children who are obese or overweight have higher risk to develop chronic diseases like type 2 diabetes and heart diseases during adulthood (2). The mechanism of obesity is complex and not fully understood yet. Factors like culture, lifestyle, and environment play a role in obesity development. Environmental factors for childhood obesity include school policy, parents' lifestyle, media and demography. Generally, it is believed that obesity is a result of high caloric and fat intake. High sugar intake, big portion size, and sedentary lifestyle are also considered as causes of increased obesity proportion among world populations. However, there is increasing evidence that suggests a genetic role in obesity development. Childhood obesity doesn't affect children health only; it has a negative effect on their academic performance, self-esteem, and life quality (3).

Huge efforts have been put in order to compact obesity and overweight in children. Programs, goals, policies, and standards have been developed as preventative actions. Educational based programs interventions must reach all regions, cultures, and socio-economic levels, as these factors play an important role on childhood obesity prevalence. Interventional programs must not reach children only but also parents, caregivers, and education providers in order to improve awareness among the whole community. Many programs combined theoretical nutritional education with practical and physical activities have been conducted in schools around the world. Schools and child centers around the world work with health practitioners and educators to conduct creative programs to prevent childhood obesity.

Research question

This study will investigate whether these educational programs have made positive changes on children dietary behavior, and to what extent these changes can prevent obesity and improve children's' health. To implement policies that support and organize nutrition education programs; policy makers need evidence-based proof of the effectiveness of such programs. This systematic review was conducted to evaluate the outcomes of various programs involving parents evaluating them as a preventative action of childhood obesity and overweight. Nutritional knowledge, food items and energy intake, anthropometric measurements and physical activities were the main variables studied in current research.

Methodology

The study has followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA 2009) [4] during all stages of implementation, and reporting of this systematic review. This review is not registered till this moment.

Eligibility criteria

The primary stage of the search has consisted of searching all published clinical trials; the standard to explain a "clinical trial" was depending on trails with humans that were possibly designed to one or more interventions (that might contain control or other placebo groups), and with goal to evaluate the impact of nutritional programs on the dietary behavior of school children. Then, the next stage has consisted of checking full-text studies that met the following inclusion criteria: (1) children aged 3.5 to 18 years; (2) programs that involved parents and take cares of children with regard to nutritional education; (3) interventional group vs. control group; (4) anthropometric measures, eating behaviors, physical activity, parental habits, dietary intake, development of toddlers, physical literacy, lifestyle behaviors, mental health, and academic performance; (5) clinical Trails. In case of the trial has more the one version, the most recent and informative one has been

included The PICOS (Participants, Intervention, Comparators, Outcomes, Study design) standards are shown in Table 1.

Table (1): PICOS standards for exclusion and inclusion of articles.

Parameter	Standard
Population	Children aged 3.5 to 18 years
Intervention	Programs that involved parents and take cares of children with regard to nutritional education
Comparators	Interventional group vs. control group
Outcomes	anthropometric measures, eating behaviors, physical activity, parental habits, dietary intake, development of toddlers, physical literacy, lifestyle behaviors, mental health, and academic performance.
Study design	Clinical Controlled Trails.

Studies' participants were school, preschool, and childcare centers with mixed gender children, their ages ranged from 3.5 to 18-year-old. Two studies' subjects were from a low-income community [5, 6]. Studies on programs were conducted in Germany, Spain, Netherlands, England, Ecuador, Canada, Brazil, Portugal, and 4 studies were in the USA. Interventional Programs included educational sessions on nutrition topics and healthy eating promotion combined with fun and physical activities. Parents took part in the programs by either attending the educational sessions or getting educating newsletters to read at home with their child. The programs periods ranged from 6 weeks to 3 years. The outcome measures included: anthropometric measures, eating behaviors, physical activity, parental habits [7], dietary intake, development of toddlers [8], physical literacy, lifestyle behaviors, one study included mental health, alcohol and drug use, social skills, and academic performance [9], resting blood pressure [4], blood and urine test [10].

Search and selection of studies

Potentially eligible studies were identified by means of a systematic search in MEDLINE®/PubMed®

(https://www.ncbi.nlm.nih.gov/pubmed/), Questia (https://www.questia.com/), Cochrane database (http://www.cochranelibrary.com/), EMBASE (https://www.elsevier.com/solutions/embase-biomedical-research) and ScienceDirect (https://www.sciencedirect.com/) from 2000 and thereafter, without language restrictions.

Search key words included: "nutritional educational program", "Dietary behavior", "Nutritional educational school-program" and "outcomes", "Child nutritional educational program effectiveness", "Nutritional program", "Dietary behavior of children" and "parents' involvement". The Boolean operators "and not", "or" and "and" were applied to join the expressions used in the literature review. Sample search strategy is illustrated in the additional file 1.

Two reviewers independently screened the titles and abstracts of all potentially eligible studies in duplicate, as well as the full text of all studies identified for further review.

Data extraction

Data were screened and extracted independently and in duplicate by 2 reviewers, by using a standardized electronic form, including information on sample group, intervention criteria, follow up period, and outcomes measures. Differences in data extracted or quality score were adjudicated by a third reviewer and then finalized in discussion among the 3 authors.

Studies' results considered positive if all outcomes measurements showed significant improvements in the intervention group, while they were considered negative if they did not show significant improvements. A mixed result is considered when some but not all outcome measurements of the interventional group showed significant improvements. The study design and the overall estimated and chosen studies are shown in Figure 1. As a consequence of this search, 12 studies have been reviewed.

Quality appraisal

To assess the quality and risk of bias in the studies the Modified Downs and Black checklist was used [11]. Twenty-seven items were included in the checklist in 5 domains: reporting, external validity, internal validity (bias), internal validity (confounding), and power. After assessment, the studies were categorized according to their scores into: excellent (between 26-28), good (between (20-25), fair (15-19), and poor (less than 14).

Results

1286 out of 3320 found articles, were full texts and accessible papers. After applying the inclusion criteria 55 relevant studies were found. The removal of the duplicate studies resulted in 41 studies. Two studies were excluded as they were not on mixed gender groups and 8 studies also were conducted before 2000. All studies conducted outside the developed countries, were excluded as well. Furthermore, a study was excluded because it targeted overweight children only. Finally, 12 articles were selected for the review that included parental involvement in the interventional program.

After assessing the quality of the selected studies by the Modified Downs and Black checklist, there have been 4 studies with excellent quality [5, 6, 9, 12], other 4 studies have good quality [13 -16], and 4 studies could not be assessed because their data collection is still ongoing [7, 8, 10, 17].

The following results were selected from the interventional studies' outcomes as summarized in Table 2:

Table (2): Summery of the reviewed studies. 12 studies have met the selection criteria and used for data extraction.

First Author, (year)	Country	Study design	Sample size	Age (y)	Length of study	Follow up	Control group	Intervention group	Quality classification	Outcomes measures
Wright et al (2012) [5]	USA	RCT	251 children	8-12	6 wk	16 mon	Usual activities	KNF ©	Excellent	Significant results for students in the intervention, included for boys decreases in TV viewing; and girls increases in daily physical activity, physical education class attendance, and decreases in body mass index z-scores from baseline to the 12 month follow-up
Greening et al (2011) [6]	USA	RCT	450 children	6-10	9 mon	9 mon	Standard health curriculum	TEAM Mississippi program	Excellent	The intervention school showed statistically significant improvement in percentage body fat, physical activity, performance on fitness tests, and dietary habits compared to the control school. There was no evidence of differences in outcomes based on gender or ethnicity/race.
Giralt et al. (2011) [7]	Spain	RCT	38 schools	7-8	3 y	3 y	Usual activities	- Classroom practice by HPA to highlight healthy lifestyle habits - Teaching practice by HPA using books designed to include the nutritional objective. - Parental activities included with their children	----------	The efficacy of the lifestyle intervention has been inconsistent. Evidence for effectiveness on anthropometrical obesity-related measures is lacking
Toussaint et al (2019) [8]	Netherland	RCT	249 children	2.5-3.5	9 mon	9 mon	Usual activities	It consists of modified versions of the programs ‘A Healthy Start’ and ‘PLAYgrounds’.	----------	- Body Mass Index, body composition, dietary intake and physical activity level of teachers and toddlers. - The activating role of ECEC teachers and the physical activity of toddlers on the

...continue table (2)

										playgrounds will be evaluated. - The knowledge, attitude and practices of parents concerning healthy eating and physical activity will be assessed
Melnyk et al (2013) [9]	USA	RCT	779 children	10-18	15 wk	6 mon	Attention control program (Healthy Teens)	COPE Healthy Lifestyles TEEN Program	Excellent	- COPE teens had a greater number of steps per day and a lower BMI and higher average scores on all Social Skills Rating System subscales. - Teens in the COPE group with extremely elevated depression scores at pre-intervention had significantly lower depression scores. - COPE teens had higher health course grades than did control teens. - At 6 months postintervention, COPE teens had a lower mean BMI than control teens. - COPE reduced the proportion of overweight teens
Patriota et al (2017) [10]	Brazil	RCT	791 children	8-12	16 mon	16 mon	Usual activities	Multi-component and environmental school-based	---------- --------	
Adab et al. (2018) [12]	United kingdom	CT	650 children	5-6	1 y	39 mon	Usual activities	WAVES program: - Helping teachers to provide 30 minutes of additional daily PA. - promoting 'Villa Vitality' (interactive healthy lifestyles learning, in an inspirational setting) - Running school-	Excellent	- The main analyses showed no evidence of between-arm differences for any secondary outcomes. - Third follow-up showed a statistically significant difference in BMI-z (MD –0.20, 95% CI –0.40 to –0.01).

...continue table (2)

								based healthy cooking skills/education workshops for parents and children and - Highlighting information to families with regard to local PA opportunities.		
Kocken et al. (2016) [13]	Netherland	RCT	1112 children	9-11	16 wk	2 y	Usual curriculum	EF! program	Good	EF! has positive effects on knowledge score & mean time spent inactively No positive effects of EF! were found with regard to anthropometric measures.
Ochoa-Avilés et al (2017) [13]	Ecuador	RCT	1430 children	12-14	9 mon	28 mon	Standard curriculum	Educational toolkits and healthy eating workshops	Good	- Participants from the intervention group consumed lower quantities of unhealthy snacks &less added sugar - Waist circumference was lower in the intervention group at the end of the program - Dose and reach were also higher at stage one.
Bogart et al (2016) [14]	USA	RCT	1368 children	12-15	5 wk	2 y	Usual curriculum	Nutrition and Exercise, school–based obesity prevention	Good	Intervention students who were classified as obese at baseline showed significant reductions in BMI percentile in ninth grade compared with control students
Rosário et al (2012) [15]	Portugal	RCT	464 children	6 -12	6 mon	6 mon	Usual curriculum	Nutrition program taught by teachers	Good	In the intervention group the increase in Body Mass Index (BMI) z-score was significantly lower than in the control group fewer proportion of children became overweight in the intervened group compared with the control
Bélanger et al. (2016) [16]	Canda	RCT	735 children	3-5	8 mon	8 mon	Usual curriculum	Healthy Start-Départ Santé	---------- -------	

Age was presented in or range. RCT: randomized controlled trials; EF!: Extra Fit; y: year; mon: month; wk: week; HPA: Health promoter agents; WAVES: West Midlands ActiVe lifestyle and healthy Eating in School children; PA: physical activity; MD: mean difference; CI: confidence interval; KNF©: Kids N Fitness intervention; COPE: Creating Opportunities for Personal Empowerment; TEEN: Thinking, Emotions, Exercise, Nutrition; CT; controlled trial

Nutritional knowledge

The results of one study showed a significant improvement in knowledge after the first- and second-year follow-up period. Both interventional and control group scores showed increased knowledge. However, interventional group had higher scores (1–2 year: 0.29, CI 0.04; 0.55; 1-2-year b: 0.36, CI 0.06; 0.65) [13]. On the other hand, there was no significant improvement in children nutritional knowledge after the interventional program in another study [6].

Food items and energy intake

Although there was no significant difference in the energy intake, fruits, and beverages consumption between the interventional and the control group in one study, there was a significant difference in vegetables and sweet snacks consumption ($p<0.10$) [13]. Three other studies showed an improvement in eating habits as well. The intake of fruits and vegetables decreased in both the interventional and control group compared to the baseline intake. However, the decrement was higher in the control group. The interventional group consumed 7% more fruits and vegetables and 5.66 g less added sugar than the control group. Moreover, the intake of unhealthy snacks was 11% higher in the control group [14]. An Improvement of fat intake was observed among the interventional group children $F(1,449) = 12.30$, $p < 0.0005$) but surprisingly not among their caregivers. Meanwhile, the caregivers of the control groups showed an increment in their dietary fat intake [6]. After the first 3 and 6 follow-up periods the assessment of the median energy intake during 24 hours showed a higher intake by the interventional group (MD of 61.5 kJ and 135.5 kJ). While after 27 months, their intake was slightly lower (MD –139.6 kJ) but these study's observations were not significant [12].

Anthropometric Measurements

All reviewed studies had positive results in the interventional groups anthropometric measurements. However, the results were not significant in two studies [12, 13].

After two years of the intervention, overweight and obesity prevalence have increased within both; the control group and the interventional group from 22.2% to 22.9% and from 19.1% to 20.2%, respectively. The multi-level analyses did not show significant effects on the BMI SD. Moreover, no effect has been found on the hip and waist circumference as well [13]. The results showed a significant reduction in the BMI in girls within the interventional group BMI ($p = 0.047$) and BMI z-score ($p = 0.05$). However, the reduction between the boys of interventional group was not significant [5]. A difference in BMI-z in control and interventional group was equal to 0.075 [95% confidence interval (CI) – 0.183 to 0.033] at 3 months and – 0.027 (95% CI – 0.137 to 0.083) at 18 months after intervention. In addition, a significant difference was found after 27 months follow up [1]. At the end of the program a decrease of the waist circumference (−0.84 cm;95% CI: −1.68, 0.28) was observed in the interventional group [14]. Although there was not a significant change in the overall BMI among the interventional group. Obese children in the interventional group at the baseline had a significantly reduced BMI after 2 years of the program ($b = –2.33$ percentiles; SE, 0.83; $p = 0.005$) compared to the control group [15].

A significant difference was found in BMI means between the interventional and control group after 6 months follow-up period (Intervention=24.72, Control=25.05, adjusted M= −0.34 [95% CI= −0.56 to −0.11]). Also, a significant change was reported in the proportion of overweight between the two groups compared to the baseline proportion (Chi-square=4.69, p =0.03). Interventional group proportion decreased from 0.4411 to 0.4156, while the control group proportion increased from 0.4101 to 0.4311. In the interventional group 2.7% has moved to the overweight category, while 7.3% from the control group has moved to that category after the follow-up period of 6 months [9].

Body fat percentage was measured and compared in a study post 9 months intervention. The interventional group percentages significantly increased, whereas the percentages of the control group remained stable

(F (1,449) = 5.56, $p = 0.02$) [6]. There was a significant variation in BMI-z levels between intervention and control groups after the 6 months program. Fewer children (5.6%) from the interventional group became overweight compared to the control group (18.4%). However, no significant difference was found in the prevalence of obesity between the two groups [16].

Physical Activity

No significant difference was found in the level and time of the physical activity and sedentary behavior between the interventional and control group in one study, both showed an increase (10%). The physical activity duration and frequency was measured by the Acti Graph, a one-dimension accelerometer [13]. Meanwhile, a significant effect was found in three studies. Results showed a significant difference in physical activity between intervention and control groups measured by a pedometer step. The interventional group had a greater number of steps compared to the control group (Intervention M=13,681; Control M= 9619) [9]. The interventional group showed an increment in involving in the program physical activity session (60 min/day) from the start of the interventional program to 4 months. This effect was sustained at 12 months follow up in boys ($p = 0.002$) and girls ($p = 0.005$). The attendance in physical education class had increased as well in both genders as well ($p = 0.003$, $p = 0.002$). At 4 months post-intervention both boys and girls decreased their TV viewing. However, only boys sustained this effect at 12 months follow up ($p = 0.030$) [5]. Another study reported a significant increase in engaging in physical activities among the intervention group, the control group showed a decline in physical activities engagement (F (1,449) = 4.56, $p = 0.04$). In addition, the interventional group children showed a significant improvement in their physical performance on two out of three tests (curl-ups, F (1,449) = 30.69, $p < 0.0001$, and the shuttle run, F (1,449) = 52.24, $p < 0.0001$) [6].

Discussion

In this systematic review, we identified 12 studies of interventions tested in Europe and America between the years 2011 and 2019. The interventions were school programs aimed to prevent and control obesity and overweight in children. The programs included educational sessions focused on nutrition, healthy lifestyle, dietary recommendations, and

healthy food choices. The other part of the programs was physical activities and physical education and promotion. We limited our systematic review to programs that involved parents and caregivers' participation since they play a major role in their kids' nutrition and lifestyle. Parents have been engaged in various educational and physical activities and workshops with their children during the interventional programs. Two programs included healthy cooking sessions for children and their parents [12, 16]. While parental involvement in two other programs was limited to newsletter and worksheets sent with their child to do at home [9, 15]. Children habits and dietary behavior is strongly affected by their parents' nutritional knowledge. Parents knowledge was translated into actions and this was reflected on their children's behavior.

The primary outcomes reviewed here were nutritional knowledge, food intake, anthropometric measurements, and physical activity. Nutrition knowledge was assessed using questionnaires [6, 13], while food intake was measured different ways such as; questionnaires [6, 13], 24-hour recall food diary [13, 14], and the Child and Diet Evaluation Tool (CADET) [1]. Four studies in this review showed positive results of the interventional program [9, 14- 16]. On the other hand, 4 studies have reported mixed results [5, 6, 12, 13]. The positive effects were mainly found in the anthropometric measurements after the last follow-up period of the studies. Positive results were found on the physical activities outcomes as well, while nutrition knowledge and food intake had mixed results. Therefore, it is concluded that programs were more effective in promoting an active lifestyle rather than healthy eating behaviors. However, most studies limited their measurements to anthropometric outcomes without considering nutrition habits and knowledge. Another limitation of this review is the variations in follow-up periods and outcome measurement techniques. In addition, questionnaires have limited accuracy and can be biased especially when they are self-reported. However, the similarity in intervention programs, target groups, and program environments is a strong point in to draw fair conclusions.

Overall conclusion, studies had shown that nutritional educational programs were effective tools for tackling obesity and for overweight prevention in children as it decreased the prevalence of obesity and overweight among interventional groups. As prevention of obesity is much recommended than treatment [18], lifestyle changes are the most

appropriate way to reduce childhood and later adulthood obesity and overweight prevalence. Such results emphasized the important role of parents in preventing obesity and overweight as reported by others [19-21].

Future programs must be implemented for prolonged periods at an international level by collaboration between schools, researchers, and stakeholders to ensure such an impact on a large scale.

Additional Files

Additional file 1: Sample search strategy. Sample search strategy to identify pertinent primary articles in PubMed.

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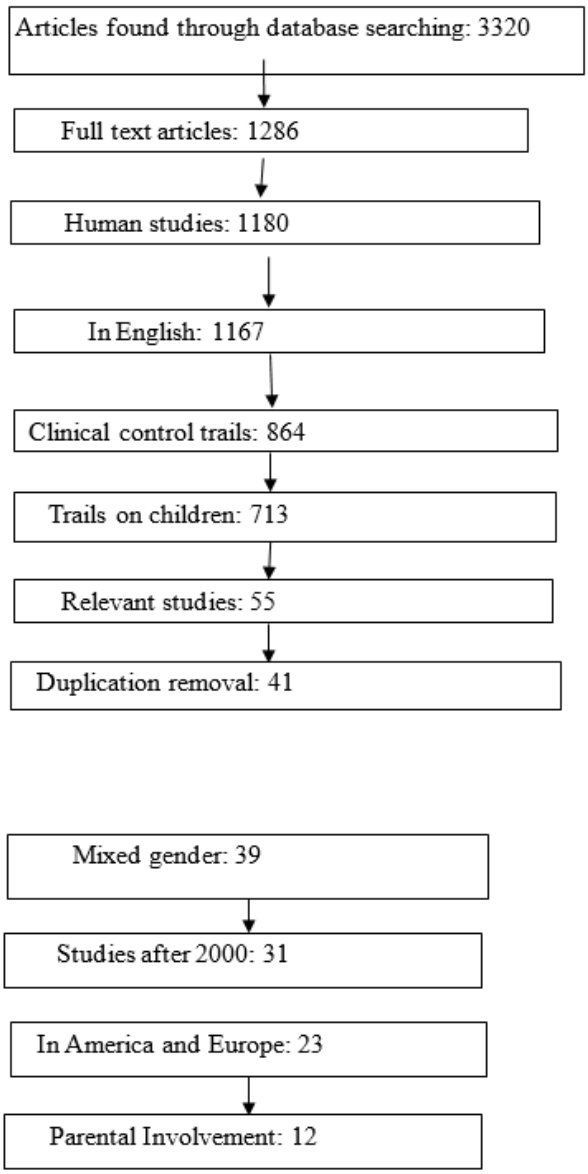

Figure (1): Inclusion Criteria. Five search engines were used to select the targeted articles.