There is no evidence to support or refute the effect of baby walkers on motor development in typically developing children

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CLINICAL SCENARIO:
The walker is an item of equipment frequently used during the period before the acquisition of independent gait in typically developing children. Some parents utilize this equipment because they believe that it helps their children to walk independently. There is a clinical assumption that the use of baby walkers has negative effects on motor development and some authors warn against the use of baby walkers, because they may be responsible for delaying the acquisition of locomotor milestones in children. To date, few studies have investigated the effect and the use of baby walkers on the early onset of independent gait.

FOCUSSED CLINICAL QUESTION:
What is the effect and use of baby walker on motor development of typically developing children?

SUMMARY of Search, 'Best' Evidence' appraised, and Key Findings:

- Six studies that met the inclusion criteria were located;
- Crouchman (1986) (level 2b), Garrett et al (2002) (level 2b), Siegel & Burton (1999) (level 2b), and Engelbert et al (1999) (level 4) were all observational low quality studies that investigated the use of baby walker in a cross-sectional manner, but did not manipulate the use of baby walker, and did not systematically follow-up the children after independent gait acquisition.
- Kaufmann and Ridenour (1977), and Ridenour (1982) (level 2b) were the only RCTs found. These two low quality studies concluded that baby walkers did not accelerate the process of acquisition of independent gait.

CLINICAL BOTTOM LINE: There is no evidence to support or refute the clinical assumption that the use of baby walkers has a negative effect on motor development.

Limitation of this CAT: This critically appraised topic has been peer-reviewed by one other independent person.

SEARCH STRATEGY:

Terms used to guide Search Strategy:

- **P**atient/Client Group: ***infants***
- **I**ntervention or **E**xposure: ***baby-walkers*** OR ***walkers***
- **C**omparison: **Nill**
- **O**utcome(s): ***motor development***

Databases and sites searched	Search Terms	Limits used
1. Medline 2. Lilacs* 3. COCHRANE 4. SCIELO** 5. EMBASE 6. Manual search of the references in the studies found	***baby-walkers*** OR ***walkers*** AND ***motor development*** AND ***infants*** (the same terms were used in all databases).	All the studies published before the date of search, with free initial year, in any language.

*** Latin American and Caribbean Literature in Health Science**
**** Scientific Electronic Library Online**

INCLUSION and EXCLUSION CRITERIA

- Inclusion: studies published either in English or Portuguese language that:
  (a) investigated the effects of the use of baby walkers on motor development in typical children at the onset of independent gait,
  (b) described the outcomes - including motor development - of a cohort of children who used a baby walker.
- Exclusion: studies that investigated the effects of the use of baby walkers in accidents; review studies; studies published in language other than English or Portuguese; studies that examined the term walker as a characteristic of a neurological syndromes (i.e., Dandy Walker) or evaluated the impact of walker use in children with disabilities.

RESULTS OF SEARCH

Twenty articles were found in *Medline*, 1 unpublished study at the *COCHRANE library*, 3 in *Lilacs,* 7 in *EMBASE* and none in *SCIELO*. Initially 8 articles were selected by the title, and the others were excluded according to the criteria described above. Of these, 4 contained in the title and the abstract terms that concerned motor development using baby walkers and were possible to be located by portal CAPES (a Brazilian webpage that gives free access to scientific publication). In addition to these 4 articles,

the reference list of these articles was searched and 5 more articles were initially selected for the review process. After reviewing these 11 records, 5 were excluded by the same criteria, and at the end, 6 articles were reviewed for this CAT.

Table 1: Summary of Study Designs of the Articles retrieved (Oxford Centre for evidence-based medicine levels of evidence)

Study Design/ Methodology of Articles Retrieved	Level	Number Located	Author (Year)
low quality RCT	2b	2	Kaufmann & Ridenour, 1977. Ridenour, 1982.
short-term cohort study	2b	2	Siegel & Burton, 1999. Crouchman, 1986.
retrospective cohort study	2b	1	Garrett et al, 2002.
case-study	4	1	Engelbert et al., 1999.

BEST EVIDENCE

The following studies were identified as the 'best' evidence and selected for critical appraisal. Reasons for selecting these studies were:

- **They were the only studies found that investigated the use of baby walker on motor development;**
- **These studies represent low level evidence, but they were the only studies available for this critical appraisal;**
- **The period of search was expanded for articles published before 2000, because of the small number of articles found.**

SUMMARY OF BEST EVIDENCE

Study 1: Crouchman. (1986)

Aim/Objective of the Study: to determine patterns of baby walker's usage and to investigate if there is an effect on the beginning of the locomotor development.

Study Design: short-term cohort study

Setting: metropolitan community - London

Participants: 66 mothers of full term infants with ages between 8 and 12 months were interviewed once (at 8 months of age) about the motor development of their children. Inclusion criteria: home care, with typical motor development at 8 months of age.

Data Collection Methods: The mothers were interviewed with closed ended questions about the motor milestones of their children: age that they independently sat and were observed dragging, crawling or shuffling, based on Touwen's stages of development. Additionally, the mothers were asked if they had a baby walker at home, and if their answer was positive, other questions were asked about what age their baby first used it and the time spent daily on the walker. The children were followed till they were able to do 7 consecutive steps on their own.

Main Findings:

- 42 babies (64%) used baby walker from an average age of 5 months and a half.
- The babies were categorized into one of 3 groups: non-users (n=24), high-users (n=20, average use = 4h/day) and low-users (n=22, average use = 1h/day).
- Twenty-one babies (50%) reportedly began using a walker before 6 months of age.
- There were no difference between groups in terms of the age of sitting and walking independently.
- The group of high-user showed a delay in the acquisition of mobility on the floor ($p<0,05$), being only 10/20 babies of this group mobile when compared to almost all babies in the non-users (20/24) and low users (16/22) groups.
- Unfortunately, the raw data were not available and the results were presented in figures (shown on page 759, original article).
- There was no significant relationship between the use of walker before the acquisition of stable sitting and subsequent delay in the development of sitting and floor mobility.

Original Authors' Conclusions*:* The development of prone locomotion was delayed in many normal babies who were reported retrospectively to spend a large proportion of their day in a baby walker. The use of this equipment did not hamper normal motor development, but appeared to be harmful if used for long periods of the day.

Critical Appraisal:

Validity/ Interpretation of Results:

Selection and data collection biases:

- There was no description of sample size estimation.
- The outcomes were based on parent report in the interview, relying on memories of their children's time exposure to the walker.
- There was no information on the validity and reliability of the instrument used to measure the acquisition of motor milestones.
- The longitudinal component (follow-up) wasn't explained – unclear how this was done, demonstrating a methodological flaw.

Results biases

- The authors concluded that prone mobility was delayed in children who were exposed to baby walkers for longer periods of time, compared to children who were not exposed to a baby walker.
- On the basis of this retrospective design, the association between exposure and the development of the intended condition (i.e., emergence of developmental milestones) was not tested in an appropriate temporal manner. Thus, the delay in the acquisition of prone mobility may not necessarily be related to the acquisition of independent gait.
- The study discusses the impact of the use of baby walker on the infants' cognition, but this outcome was not measured.

- The authors also suggest that the amount of time using baby walker may impact positively or negatively on infant's motor development.
- It was argued that although high users (i.e., infants who spent longer periods of time using baby walker – over 4 hours/day) showed delay in prone acquisition, motor acquisition could be accelerated among low users (i.e., infants who spent, on average, 1 hour/day using baby walker).
- The acquisition of independent walking wasn't delayed, however, the author inferred about possible delays in the acquisition of independent walk as a result of baby walker use.

Summary/Conclusion: The conclusions of the authors about the delay in prone mobility among children exposed to baby walkers, and the impact of it in acquisition of independent gait are inappropriate. Studies relying on parents memories show methodological biases to investigate the possible effects of the use of baby walker in motor development. Studies using a retrospective design to investigate the relationship between the use of baby walker and the acquisition of developmental milestones cannot provide strong evidence about the ordering of these variables in a developmental lifespan.

Study 2: Engelbert et al. (1999).

Aim/Objective of the Study: To describe the case studies of two children that after the use of a baby walker showed delayed motor development and motor patterns similar to that observed in children with spastic diplegia.

Study Design: Case-study

Setting: University Hospital for Children and Youth - The Netherlands

Participants: Two case studies of children without complications during gestation or delivery, who showed normal motor development up to the beginning of baby walker usage. Case 1: 11 month-old child, with toe-walking and contractures of the calf muscles. Case 2: 19 month-old child, with delayed motor development, abnormal, asymmetrical crawling and intermittent hypertonia in the right leg. Children were referred to physical therapy treatment because of their clinical features.

Description of the cases: Case 1: began the use of baby walker at 6 months of age (when the child was capable of independent sitting) for several hours a day. Case 2: began the use of baby walker at 12 months of age, when the child was capable to come to stand on his own, stand with support and side-stepping. The use of baby-walker was freely chosen by the parents, and they were only referred to treatment when concerned about their children's motor development. Parents were advised to withdraw the baby walker at the beginning of physical therapy intervention, but there was no description of the type of treatment applied.

The parents described children's motor development before the use of the baby walker. The physical therapy assessment in the beginning of the study was based on anthropometric measurements, observation of the quality of movements, muscle tone (according to Amiel-Tison), ROM, tendon reflexes, general observation of motor skills according to Bayley (such as rolling over, sitting, standing, walking). No references on

the Bayley content was presented, neither the scores nor the statistical analysis of data were presented. The other measures were not standardized. At the age of two years, the children were re-evaluated (no data presented), and the authors concluded that motor development of both children were normalized with age-appropriate quality of movement, muscle tone, muscle strength and range of motion.

Main Findings: No data was presented in the study, only qualitative description of the cases. In the discussion, the authors argue that the motor patterns of the children who learned to walk with the use of a baby walker seem to have a tendency to develop contractures, high muscle tone, and abnormal posture of lower extremities, a pattern that is very similar to the one observed in children with spastic diplegia.

Original Authors' Conclusions: "*Children that use baby walker develop stiff-knee gait, a leaning forward of the trunk due to hip flexion, and a decreased stride length. The walker prevents the practice of equilibrium and protection reactions that should be developing*" (page 275, middle of the first paragraph). The authors argued against the use of baby walker, based on the observed delay in motor development, on the poor quality of motor performance and on the vulnerability to accidents.

Critical Appraisal:

Validity/ Interpretation of Results:
Selection and data collection biases:

- The type of study does not allow generalizations (case-study: lowest level of evidence on therapy effectiveness).
- The cases are not comparable, because the children began and ended the use of baby walker at different motor development stages.
- The number of participants was extremely small.
- There wasn't any control of baby walker use and measurement of motor development prior to inclusion in this study was based on parent's memories.
- Additionally, the instruments used to evaluate motor development were not described, valid or reliable, and no raw data from children's assessment were presented (i.e., ROM, muscle tone, age of acquisition of motor development)

Results biases:

- There was no description of the type of physical therapy implemented and no statistical analysis was used to allow conclusions that motor development was normalized.
- The data acquired at re-evaluation was not presented, neither were the children's motor patterns described, concluding that it was normal age-appropriate without comparing and accompanying normal developing children as controls for this study.
- The conclusions of the authors that the children seemed to look like diplegic spastic children were not substantiated with objective measures.

Summary/Conclusion: The low level of evidence represented by these two case studies, the absence of a more precise description of the time the children used the baby walker (both amount of use and onset), details of the treatment conducted and raw data of the evaluations do not permit any conclusion and generalization.

Study 3: Garrett et al. (2002).

Aim/Objective of the Study: To compare the age at which children that used baby walker and non-users achieved locomotor development.

Study Design: Retrospective cohort study.

Setting: Day Care Centres - Ireland

Participants: 250 parents whose infants were born at term and were attending one of nine day-care centers randomly chosen out of 31 centers were selected to participate in the study. Sample size estimation determined a total of 200 children/parents necessary to provide sufficient data to have 90% power to detect a two week difference in the mean age at achieving the developmental milestones. The children were selected at day-care centers registered in the Foyle Health and Social Services Trust in Ireland.

Data Collection Methods: a brief questionnaire was given to the parents, based on the Northern Ireland personal child Healthcare Report, which registered the ages in that parents recorded retrospectively that their children achieved 9 motor milestones: raising head in prone, rolling over, sitting with support, sitting alone, crawling, standing with support, walking with support, standing alone and walking alone. Additionally, questions concerning baby walker usage or not (i.e., age of beginning and ending of baby walker usage, and total hours of daily exposure to the equipment) were asked for the parents to report them based on their memories. Of 250 parents approached, 207 (83%) responded to an oral, brief, circulated, anonymous and confidential questionnaire. Seventeen premature infants were excluded, leaving 190 valid responses. The age of the children when the questionnaire was filled in wasn't reported.

Main Findings: 102 children used baby walkers (54%), the average age of the beginning and ending of usage was 26 and 54 weeks, respectively, with an average of 26 weeks of use. 88 children were non-users of baby walker. The t-test showed that the baby walker users group acquired motor milestones such as crawling, standing alone and walking alone at a later time, without changes in the acquisition of other motor milestones (see table 1). There was also a relationship between the amount of baby walker use and the extent of developmental delay. Results from the linear regression showed that each aggregated 24 hours of baby walker usage was associated with a delay of 3.3 days (95% confidence interval 2.5 to 4.1) in walking alone and 3.7 days (95% confidence interval 2.9 to 4.4) of standing alone.

Table 1: Results from the *t*-test showing significant differences in mean age of acquisition of milestones*.

	Mean age milestones achieved			***t* test (df=188)**	
Milestone	Baby walker non-users (n=88)	Baby walker users (n=102)	Difference between baby walker user and non-users (95% CI)	P value	*t* score
Crawling	35.16	31.26	-3.90 (-5.32 to -2.47)	<0.0001	-5.40
Stand alone	53.68	57.00	-3.32 (-4.87 to -1.77)	<0.0001	-4.22
Walking alone	58.14	61.12	-2.98 (-4.51 to -1.45)	0.0002	-3.85

CI: confidence intervals

* Data for this table were extracted from Table from Garrett et al., 2002, page 1494.

Original Authors' Conclusions: *"This study provides additional evidence that baby walkers are associated with delay in achieving normal locomotor milestones… The use of baby walkers should be discouraged"* (page 1494, last paragraph).

Critical Appraisal:

Validity/ Interpretation of Results:
Selection and data collection biases:

- The information regarding the achievement of motor milestones and the amount of time of walker usage was based on parental report and memories.
- The instrument used to measure the outcome of interest and described in the study doesn't have published reliability and/or validity.
- Descriptive characteristics of children from the two groups were not presented.
- Such lack of information may raise questions about the validity of the conclusions, as it is possible that observed differences may have been present at the beginning of the study.

Results Biases:

- The authors conclude that the use of baby walkers was associated with locomotor milestones delay, but these data were not obtained using standardized (objective) measures.
- Cross-sectional studies are not appropriate to infer about future motor development.

Summary/Conclusion: This study shows limitations in answering the clinical question. One limitation is attributed to the lack of control of important information, such as beginning of baby walker use, time of usage per day/months and type of baby walker used, which relied exclusively on the parental memory. Additionally, the authors did not use a standardized test to assess motor development, limiting inferences about the presence of motor delay in the sample.

Study 4: Kaufmann & Ridenour. (1977).

Aim/Objective of the Study: To compare the acquisition of bipedal gait, in children who were regular users of baby walker and children who didn't use this equipment.

Study Design: Randomized controlled trial, with children being randomly allocated. Allocation was not concealed. The procedures used, and person conducting the randomization were not described.

Setting: Research Laboratory – New Jersey

Participants: six pairs of fraternal twins, all males, with 300 days of age. In each pair, one of the twins was randomly selected to use a baby walker (treatment group). The other twin was allocated to the 'reference group' (or control group). The way the boys were recruitment was not clarified, neither were their baseline demographic variables.

Intervention Investigated: the *treatment* group used the walker for a total of 2 h/day, and the parents were responsible for this practice, with no rules regarding the distribution of walker training time. The height of the canvas seat in the baby walker was adjusted to enable the infant to place the plantar surfaces of the feet flat on the supporting surface with the leg in full extension. The equipment was used until the acquisition of independent gait. The *reference* group didn't receive any specific training.

Outcome Measures: registration of beginning of independent gait and qualitative EMG of muscle activation (from lower limbs), at the onset and 30 days after acquisition of gait. There wasn't any information about how the measurements were conducted, neither who did the measurements.

Main Findings: the reference group walked at a mean age of 368 days and the treated group at a mean age of 382 days. However, these parameters were not statistically tested compared. The first EMG analysis was performed at the moment that children from the reference group walked 4 steps unassisted, but at that time, the treatment group had only 4 children walking unassisted. A second evaluation was conducted 30 days after the first measurement. The EMG data were correlated to video recordings. No raw data were presented, only an average full wave figure of the muscles tested, making it impossible to calculate confidence intervals (figure shown on page 1325 in the original article). Qualitative analysis of EMG traces suggested that the use of walker modified the mechanics of infants´ locomotion in various aspects (muscle activation, joint positions, weight support, position of the centre of mass, lateral displacement of body). Some differences persisted on the second evaluation, when all children walked unassisted and were evaluated without the walker. Such conclusions were not statistically tested.

Original Authors' Conclusions: after cessation of the use of walker, children from the treatment group tended to adjust their movements to resemble more closely those from the reference group. However, as the EMG analysis suggests an inappropriate gait pattern among the walker's users, this equipment should be questioned. The training with the walker didn't accelerate the process of acquisition of infants´ independent gait.

Critical Appraisal:

Validity/ Interpretation of Results:

- The PEDro Score for this study was 1/10, which shows' the low methodological quality of this RCT and susceptibility to bias (the items scores were: Eligibility criteria: No; Random allocation: Yes; Concealed allocation: No; Baseline comparability: No; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: No; Point estimates and variability: No).

Selection and intervention biases:

- There were no demographic data about the subjects that participated in this study.
- The treatment group interrupted the training before all the children achieved the same level of locomotor development.

- The age at which infants began using the walker seemed appropriate (mean 300 days of age), because at this stage of development it is expected that children support their weight on their feet.
- Even though the use of the walker was prescribed only for one of the twins, there is doubt if the other sibling did not really use it, since they lived in the same environment.

Results Biases

- The qualitative analysis from the EMG tracings presented in the figure doesn't substantiate the conclusions that children that used the baby walker had inappropriate gait pattern. For such conclusion, the gold standard measurement of gait pattern analysis is conducted by means of 3D motion analysis system, and this was not used in this study.
- The EMG shows limitations for between subjects' comparisons, because there was no normalization, rectification or filtration of the signals to allow interpretations (probably because this is an old study).
- No raw data were presented to allow readers to analyze the results.
- There was no follow-up to confirm the conclusions of the study.
- Besides the EMG tracings that seemed to look different in the group that used the baby walker, both groups acquired mean independent gait acquisition in similar ages, which weren't tested statistically.

Summary/Conclusion: there is no reliable evidence from this study that justifies the authors´ argument for the non use of baby walker in typically developing children, because there wasn't any delay in gait acquisition, and EMG data was not properly transformed to allow comparisons.

Study 5: Ridenour. (1982)

Aim/Objective of the Study: Investigate if the use of baby walker influences the time of acquisition of independent gait in infants.

Study Design: Randomized Controlled Trial, with the children being randomly allocated. Allocation wasn't concealed. The procedures used for, and person conducting the randomization were not described

Setting: suburban Philadelphia area

Participants: 15 pairs of non-identical twins at 4 months of age (no gender described), participated in this study; one of the twins was randomly assigned to the experimental group and the other to the control group. The way the infants were recruited was not clarified neither was information on their baseline demographic variables. Twins were selected for this study to control environmental variables that may influence the onset of walking.

Intervention Investigated: use of the same baby walker manufactured by Jimmy (1975), 1 h/day starting at 4 months of age until the acquisition of bipedal locomotion. The control group did not make use of baby walker. These are all the details the article provided.

Outcome Measures:
(1) Monthly visits and weekly telephone calls to assure that the procedures defined for the intervention and the control groups were being followed.
(2) Primary measure: the date of gait acquisition was registered in days (post-term), by a home visit on the day the child could perform a sequence of 3 steps unassisted.

Main Findings: All the infants were followed-up until the acquisition of independent walking. The mean age of independent walking in the experimental group was 371 ± 47 days x 370 ± 49 days in the control group, with no statistical difference between groups ($p>0.05$).

Original Authors' Conclusions: The baby walker did not accelerate the process of independent gait acquisition.

Critical Appraisal

Validity/ Interpretation of Results:

- The PEDro Score for this study is 3/10, which shows' the low methodological quality of this RCT and susceptibility to bias (the items scores were: Eligibility criteria: No; Random allocation: Yes; Concealed allocation: No; Baseline comparability: No; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes).

Selection and intervention biases:

- There were no demographic data on the subjects that participated in this study.
- The treatment group interrupted the training before all the children achieved the same level of locomotor development.
- The study control was conducted by home visits and weekly phone calls, which does not assure that the conditions were necessarily followed.
- There are no ethical considerations and the beginning of walker use seems to be too early (i.e., 4 months of age): at this age children don't have muscle-skeletal conditions to maintain the standing posture.

Results biases:

- No standardized test was used to document longitudinal changes in infants' motor development
- Despite the early beginning of baby walker usage, the treatment group didn't show delayed gait acquisition, acquiring independent gait at a similar age in relation to the control group (i.e., twin that didn't use the baby walker).
- It is difficult to control that the other twin also didn't use the walker.

Summary/Conclusion: this study introduced the baby walker at very early ages, and no standardized test was used to document longitudinal changes in infants' motor development. Furthermore, there were no differences between groups in their age of independent gait acquisition.

Study 6: Siegel & Burton. (1999)

Aim/Objective of the Study: To study the effects of the use of baby walker on motor and mental developmental outcomes, in typical children.

Study Design: short-term cohort study

Setting: metropolitan community in New York.

Participants: the infants´ sample was recruited from a large pool of parents who responded to a baby walker questionnaire. A total of 109 children were divided into two groups: walkers (n=56) and no-walkers (n=53). Twenty-six (46%) of the walker and 29 (55%) of the no-walker group were female. The walker group was subdivided into: occluding-walkers (n=37) and see-feet walkers (n=19). The inclusion criteria were: full-term birth, absence of neurological and physical deficits, and children of 6, 9 or 12 months of age at the time of the initial evaluation. Thirty-four infants were 6 months old, thirty-five infants were 9 months old, and 40 infants were 12 months old, at the initial testing. These, eighteen (53%) of the 6 months old, nineteen (54%) of the 9 months old and nineteen (48%) of the 12 months old, were exposed to baby walkers.

Data Collection: Variables like frequency, time of exposition and age of the beginning of walkers use were not controlled and collected based on parental memory. The Bayley Scales of Infant Development (i.e., mental scale; 0 to 178 items, motor scale: 0 to 111 items) and a questionnaire responded by the parents were used to measure the motor developmental milestones (sit, crawl and walk). These measures were administered at 6, 9 or 12 months of age and repeated 3 months later. Before the first testing session and subsequent interview for each infant, the experimenter was blinded regarding walker use and group allocation.

Main Findings:

Age of beginning and time spent in walker exposure:

- the authors reported that the mean time of walker use was 2,3 hr/day (SD = 1,5 hr/day), being this outcome reported by the parents
- The mean age of walker use onset was 4,8 months (SD = 1,5 months) and its use ended at 10,1 months (SD = 2,1 months).

Motor milestones

- The results from MANCOVA showed that the occluding-walker group achieved sitting and walking latter than the other groups. And the no-walker children crawled earlier than either see-feet walker or occluding walker children, who were not different from each either (see table 2).

Table 2: Mean age (in months) and SD at acquisition of motor milestones

	Milestone					
	Sitting		**crawling**		**walking**	
Walker group	mean	SD	Mean	SD	mean	SD
Occluding-walker (n= 37)	6.73[a]	1.30	6.68[c]	1.38	11.66[e]	1.41
See-feet walker (n=19)	5.99[b]	1.33	6.23[c]	1.32	10.70[f]	1.66
No-walker (n=53)	5.39[b]	1.06	5.84[d]	1.23	10.82[f]	1.51

SD: standart deviation; Column means with different superscripts are significantly different from each other
Significance: Sitting = p<0.000; Crawling = p=0.03; Walking = p=0.02
* Data for this table were extracted from Table 2 from Siegel & Burton, 1999, page 358.

Motor and mental scores (Bayley)

- The MANCOVA analysis showed that the occluding-walker group had significantly lower motor and mental scores from the Bayley scales, in relation to the see-feet group and to the no-walker group (see table 3).
- The walker group x age group interaction showed that the mental scores were only significantly different across group ages at 6 and 9 months, being lower in occluding-walker group, and in the see-feet group in relation to the no-walker group (see table 4).

Table 3: Means and SD of Bayley Mental and Psychomotor Developmental Indexes*

	Motor		**Mental**	
Walker group	Mean	SD	Mean	SD
Occluding-walker (n= 37)	106.81[a]	13.05	113.15[c]	13.58
See-feet walker (n=19)	114.11[b]	10.89	116.76[cd]	14.29
No-walker (n=53)	120.58[b]	12.01	123.16[d]	13.18

SD: standart deviation
Column means with different superscripts are significantly different from each other
Significance: Motor = p<0.000; Mental = p<0.003
* Data for this table were extracted from Table 3 from Siegel & Burton, 1999, page 358.

Table 4: Means and SD of Bayley Mental Developmental Indexes across group ages at 6 and 9 months

	Mental	
Walker group	Mean	SD
Occluding-walker (n= 37)	117.4[a]	19.54
See-feet walker (n=19)	110.8[a]	9.84
No-walker (n=53)	129.6[b]	13.60

SD: standart deviation
Column means with different superscripts are significantly different from each other
Significance: Mental = p<0.05
* Data for this table were extracted from text in results from Siegel & Burton, 1999, page 358.

Effects of use of baby walker

- In relation to the other variables, multivariate multiple regression analyses showed that the latter offset of the use of the walker predicted lower motor scores (t[50] = 3.75, p<0.000, β = -0.51, r = -0.41) and later onset of independent walking (t[52] = 4.07, p<0.005, β = 0.55, r = 0.44).
- the greater the frequency of walker use the lower the mental scores (t[50] = -2.56, p<0.01, β = -0.41, r = -0.37).

Original Authors' Conclusions: Only the occluding-walker seems to have negative effects on the development of sitting and walking, and see-feet walker didn't promote motor development, as hypothesized.

Critical Appraisal:

Validity/ Interpretation of Results*:*

Selection and data collection biases:

- The reliability and validity of the questionnaire applied to the parents wasn't reported.
- The number of participants in each group was not equivalent, principally in the baby walker groups.
- There wasn't any control of time of exposure to the walker and initial information regarding motor development was based on parent's observation and memory, and not by standardized tests.

Results biases:

- The time of follow-up in this study was small to conclude that these children had permanent delay on mental and motor development.
- One major result of worst performance for the occluding-walker group (i.e., mental developmental outcome), was significant in an age phase that independent gait hasn't been achieved yet (i.e., 6 to 9 months).
- Changes on Bayley scores seems appropriate, but it's difficult to interpret because the results were presented as indexes that correspond to raw score transformation and are dependent on the age of each child when the data was collected; information on the raw scores and the child's age wasn't presented.
- The authors argued that after discontinued walker use, children who used walker and showed developmental delay might have catch-up the children who didn't use the equipment, however, such argument was not substantiated with evidence from his study.
- Cross-sectional studies are not appropriate to infer about later motor developmental outcomes.
- The authors generalized the results beyond the sample studied (i.e., children with neurological deficits) without any data to confirm the conclusions.
- At the end, the authors recommend the ban of walker use, based on other studies that investigated the frequency of accidents using baby-walker, but this variable was not investigated in this study.

Summary/Conclusion: This study was the only that used a valid and reliable tool to assess motor development (i.e., Bayley Scales of Infant Development) and showed mean and SD of results. Furthermore, this study was also the only one to follow-up the children that used the walker during the period of three months after identification of walker exposure. Besides these good characteristics, this study had a few methodological weaknesses (reliance on parent's memories, different types of baby walkers, and different ages of follow-up) and some conclusions do not allow generalizations. Another important conclusion is the authors argued that motor development of children exposed to baby walker could catch-up to that of their no-walker peers. This hypothesis was not empirically tested in this study. This argument may illustrate a possible explanation against the clinical assumption that baby walkers have negative effects after children's exposure.

Table 2: Summary of the characteristics of studies included in this CAT

	Study 1 Crouchman 1986 **N = 64**	**Study 2** Engelbert et al., 1999 **N = 2**	**Study 3** Garrett et al., 2002 **N = 190**	**Study 4** Kaufmann & Ridenour, 1977 **N = 6**	**Study 5** Ridenour, 1982 **N = 15**	**Study 6** Siegel & Burton, 1999 **N = 109**
Study Design	Cohort-study (2b)	Case-study (4)	Cohort-study (2b)	RCT (2b)	RCT (2b)	Cohort-study (2b)
Equipment use	Use of baby walker	Use of baby walker	Use of baby walker	Use of baby walker	Use of baby walker	Use of baby walker
Outcomes measured	Age of motor milestones acquisition	Clinical neurological evaluation and Bayley	Age of motor milestones acquisition	Age of gait acquisition and EMG analysis	Age of gait acquisition	Bayley and age of motor milestones acquisition
Findings	Delayed prone mobility	Delayed motor development and modified gait pattern	Delayed motor development	No difference in age but different EMG	No difference	Delayed motor development

IMPLICATIONS FOR PRACTICE

Checking the validity of the results of the studies:
The studies critically appraised in this CAT to respond to the question **"What is the effect and use of baby walker on motor development of typically developing children?"** showed:

- low methodological quality,
- small sample size: the number of participants seemed to be small (only one study showed sample size calculation),
- an absence of information regarding the validity and reliability of almost all the instruments used to measure the outcomes, and
- the baby walker use wasn't controlled and systematized in almost all the studies (i.e., based on parents information).

Results/ Applicability: Most of these studies argued against the use of a baby walker because this equipment might delay or alter the achievement of locomotor milestones. Our opinion regarding their conclusion is that such argument should be limited to the general characteristics of the study procedures and sample:

- Some studies introduced walker use at a young age (i.e., between 4 and 6 months of age). Most studies did not control for walker exposure, and it is possible that such negative effects argued by the authors would not be observed if baby walkers´ were introduced at a later stage.

- Ridenour (1982) study initiated walker use at a very early age (i.e., 4 months) and controlled the walker usage (i.e., 1 hour per day) in a low quality RCT study until gait acquisition. This study did not find any age difference in gait acquisition.

- Control of the amount of time of baby walker use is essential when making inferences about effect on an infant's developmental outcome.

- Almost all studies used a cross-sectional design, which can't inform us about future motor development, but it is appropriate to respond the question of what age the child acquired specific motor milestones.

- The two studies that used an RCT design showed many methodological biases (such as absence of eligibility criteria, small underpowered sample, absence of concealed allocation, absence of baseline comparability, no blinding of subjects or assessors, no intention-to-treat analysis). Furthermore, they didn't observe differences between group age of independent gait acquisition.

- Almost all authors generalized the results from their study beyond what was investigated. For example, some studies argued against baby walker use because of the possibility of high frequency of accidents, but this variable was not investigated in any of the studies included in this CAT.

IMPLICATIONS FOR FUTURE RESEARCH

Future research about the effects and use of baby walker should attempt to the following procedures:

- measurement of motor milestones should use standardized measures to quantify motor development (such as the Alberta Infant Motor Scales, the Bayley Scales of Infant Development, the Peabody Developmental Motor Scales II, Toddler and Infant Motor Evaluation).

- follow-up of children should go beyond independent gait acquisition, in order to investigate whether possible effects are persistent after the onset of locomotion (and consequently, might be attributed to the use of baby walker);

- in order to allow for causal inference between walker exposure and delay in motor development is it necessary that authors make use of study designs such as randomized controlled trials. Furthermore, controlled prospective cohort designs could be used to investigate the relationship between these variables;

- control time spent using the walker to move around the environment, as well as for type of walker exposure.

CONCLUSION

With this critical appraisal we can't conclude much about the real effects and use of baby walker on typically developing children's motor outcomes, because the studies represent limited evidence, encouraging new studies in this area.

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