Trends in Medical Research

ISSN 1819-3587

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS Trends in Medical Research

ISSN 1819-3587
DOI: 10.3923/tmr.2016.76.81

Research Article
Effect of Usage of Baby Walker on Acquisition and Pattern of Independent Gait in Normal Children

Marian Magdy Shafeek and Emam Hassan El-Negmy

Department of Physical Therapy for Growth and Developmental Disorder in Children and its Surgery, Faculty of Physical Therapy, Cairo University, Egypt

Abstract
The purpose of this study was to investigate the effect of using baby walker (bw) on acquisition and pattern of independent gait in normal children. One hundred normal children of both gender with age ranged from 6-10 months participated in this study, they were recruited from day care center, nursery, health care office and waiting room of pediatric clinics. Parent of all participants signed the informed consent. The children met the inclusive and exclusive criteria. They were categorized according to using baby walker into three groups: Group (A) didn't use bw, group (B) low users of bw and group (C) high users of bw. The age of acquisition of independent walking were registered by days for all children in all groups (A, B and C) by following up the children, two methods were used to evaluate gait pattern which included digital camera with AutoCAD motion program and foot print techniques. The results revealed statistically significant difference between the three groups (A, B and C) in age of acquisition of independent gait in favor of group A and also statistically significant difference was recorded in all gait parameter and gait pattern between the three groups and most of these differences came in favor of group A and that reflect the effect of baby walker in delayed gait acquisition and disturbed normal gait pattern in newly walker children.

Key words: Baby walker, gait acquisition, gait pattern, ASQ, AutoCAD, MANOVA

Received: December 03, 2015 Accepted: February 02, 2016 Published: March 15, 2016

Citation: Marian Magdy Shafeek and Emam Hassan El-Negmy, 2016. Effect of usage of baby walker on acquisition and pattern of independent gait in normal children. Trends Med. Res., 11: 76-81.

Corresponding Author: Marian Magdy Shafeek, Department of Physical Therapy, National Institute of Neuro-Motor System, General Organization of Hospital and Institutes, Egypt

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Child development is a complex process which is completed in time and through the maturation of the central nervous system. This process is affected by the genetic, ethnic, nutrition, social and economic backgrounds (Beckett and Taylor, 2010). One of the factors supposed to be effective in the acquisition of motor skills is the use of baby walker.

A baby walker is a metal and plastic frame on wheels, in which a baby is suspended in a canvas sling-seat. Children usually use them between the ages of 5 and 15 months. Baby walker allow a pre-walking (pre-ambulatory) child to move about by pushing his feet against the ground (Murphy and Nicholson, 2011).

Some parents use baby walkers because they believe that they help their babies to walk and that they are safe to use. Professional opinion is generally hostile. Baby walker use has been controversial for some years and many health professionals actively attempt to dissuade parents from using them (Burrows and Griffiths, 2002).

Although some parents begin to use mobile baby walkers once their baby is four to five months old, many experts think that they are too dangerous to be used routinely. In addition to falls down stairs and falls out of their walker, many infants are injured each year as their mobile baby walker makes them too mobile and able to get to things that would otherwise be out of reach, even if you have started childproofing your home (Australian Physiotherapy Association, 2007).

The number of injuries from baby walkers has led the Canadian government to ban the sale, advertisement and importation of baby walkers in Canada since 2004 (Health Canada, 2013), Also the American Academy of Pediatrics recommends a ban on the manufacture and sale of infant walkers as it has happened in Canada (Mack *et al*., 2008).

Investigations into the development of standing and walking in infants who used baby walkers obtained conflicting results. Crouchman (1986) and Siegel and Burton (1999) found that the use of baby walkers was associated with delay in crawling. Kauffman and Ridenour (1977) and Crouchman (1986) revealed that no significant differences in achieving independent walking in infants who used baby walkers compared with non-users, while Garrett *et al*. (2002) and Siegel and Burton (1999) found that baby walker users achieve independent walking at a later age than non-users.

The Ages and Stages Questionnaire-3 (ASQ-3) is a widely used screening tool for infants and young children assessing development in five domains: communication, gross motor, fine motor, problem solving and personal social. The ASQ is designed to screen young children for developmental delays that is, to identify those children who are in need of further evaluation and those who appear to be developing typically. The ASQ is a series of 21 parent-completed questionnaires to allow measurement of development from aged 1-66 months (Squires and Bricker, 2009).

To date, few studies have investigated the effect of uses of baby walkers on the early onset of independent gait and till now no Egyptian study was conducted to confirm the baby walker effect on Egyptian children. The main aim of this study was to investigate the effect of baby walker usage on the time of acquisition of independent gait and initial gait pattern.

MATERIALS AND METHODS

Subjects: Hundred normal children from both gender participated in this study. This experimental study was conducted during the period from September, 2014 to August, 2015. Children were recruited from day care center, nursery, health care office and waiting room of pediatric clinics. They were selected according to the following criteria:

- **Inclusive criteria:**
  - Full term infant
  - Their age ranged from 6-10 months (didn't reach age of independent gait)
  - They followed typical motor development according to ASQ-3
- **Exclusive criteria:**
  - Children with physical or neurological disorder
  - Children with hearing or visual defects
  - Children who obtained score lower than cutoff in ASQ-3 for their age

According to using baby walker children were categorized into three groups:

- Group A: Non-users baby walker children
- Group B: Low-users baby walker children
- Group C: High-users baby walker children

High user: Mean that the child started using the baby walker before the age of 7 months for at least 3 h day^{-1}.

Ethical consideration: Approval from the ethical committee of the Faculty of Physical Therapy, Cairo University as well as

written consent from the children parents was obtained before starting the study.

Instrumentation:

- **Ages and stages questionnaires:** Is a screening test used to identify any developmental delays in children
- **Child sheet:** To collect information about child
- **Digital camera:** (Nikon COOLPIX L330) for video recording of child movement
- AutoCAD motion analysis program for analysis of the gait pattern
- **Reflected dots:** Circular markers were placed on the anatomical landmarks to determine the center of the measured joints
- Tape measure, height and weight scales
- Walk way
- Two different color print and marker

Procedure:

- Children mothers were interviewed first to complete Age and Stage Questionnaire (ASQ). According to child chronological age the questionnaire was selected. If the obtained score lower than cutoff score for these developmental area (gross motor) that means child was excluded from the study
- Mothers also filled out child sheet which contain information about the child and his mother for easy following up the child and also contain information about the uses of baby walker, the age of starting using the walker and total hours of daily uses of the walker and according to mothers answer the children were categorized into the three groups (A, B and C)
- Children in three groups were followed until acquisition of independent gait and then:
    - Date of acquisition of independent gait was registered by the day the child became able to do few unassisted steps
    - Within one week from that day, the child was interviewed to confirm that he/she was able to do few unassisted steps and applied analysis of gait pattern

- **Analysis of gait:**
    - A reflected dots were placed on the anatomical landmarks: acromion, greater trochanter, lateral femoral condyle of knee, lateral malleolus and 5th metatarsal bone in both sides
    - After fixing white walk sheet on the floor, the child was encouraged to walk on this sheet by following his mother walking or by encouraged him to reach toys with bright color and music sound in the end of the walk way
    - The child's movement was recorded by digital video camera from sagittal view, the digital video camera was placed perpendicular to the side of the walk way and 50 cm above the floor and 1.5 m away from the center of the child body to provide full view without using zoom
    - AutoCAD motion analysis program was used to connect the reflected dots and calculate the angles of hip, knee and ankle joint during initial contacts
    - Step length, stride length, step width, cadence and velocity was calculate by infant foot print on the white walk sheet using tap measure and stop watch

Statistical analysis: Statistical analysis was conducted using SPSS for windows, version 18 (SPSS, Inc., Chicago, IL). Between Subject MANOVA was used to compare the tested variables (age of gait acquisition, weight, height, stride length, step length, step width, cadence, velocity and ROM of hip, knee and ankle joints) at different tested groups (group A, B and C). Between subject MANOVA was performed on the examined sample with the alpha level 0.05.

RESULTS

The main purpose of this study was to investigate the effect of using baby walker on acquisition and pattern of independent gait in normal children. One hundred normal children participated in this study but only 87 children were continue to final evaluation and the other 13 children were excluded. The remaining 87 children were categorized according to use of baby walker into three groups (A, B and C) as shown in Fig. 1.

Descriptive statistics and one way Multivariate Analysis of Variance (MANOVA) for age of gait acquisition, weight, height, stride length, step length, step width, cadence, velocity and ROM of hip, knee and ankle joints at the three groups A, B and C are presented in Table 1, while multiple pairwise comparison tests (*Post hoc* tests) for all dependent variables are presented in Table 2.

Table 1: Descriptive statistics and one way multivariate analysis of variance for the three groups

Variables	Group A	Group B	Group C	F-value	p-value
Age (days) of gait acquisition	380.340±35.23	398.250±25.34	414.80±14.31	6.911	0.002*
Weight (kg)	10.650±0.372	10.720±0.252	10.69±0.363	0.458	0.634
Height (cm)	75.280±2.79	75.510±2.45	75.50±2.27	0.077	0.926
Stride length (cm)	25.142±1.18	25.060±1.33	18.93±0.711	114.27	0.000*
Step length (cm)	12.560±0.584	12.509±0.67	9.46±0.355	112.89	0.000*
Step width (cm)	15.205±0.819	13.140±0.68	13.11±1.102	71.564	0.000*
Cadence (Steps per minute)	153.130±7.26	166.940±8.66	178.40±3.405	56.718	0.000*
Velocity (m min^{-1})	19.220±1.44	20.860±1.34	16.81±0.54	40.752	0.000*
Hip ROM (degrees)	40.018±2.89	31.860±2.15	28.40±2.001	142.699	0.000*
Knee ROM (degrees)	34.410±1.95	23.430±1.62	30.47±2.25	341.852	0.000*
Ankle ROM (degrees)	112.620±3.17	123.690±2.16	132.49±1.20	308.763	0.000*

*Significant at alpha level <0.05

Table 2: Multiple pairwise comparison tests (*Post hoc* tests) for all dependent variables

Variables	Group A vs. Group B	Group A vs. Group C	Group B vs. Group C
Age (days) of gait acquisition	0.002*	0.004*	0.345
Weight (kg)	1.00	1.00	1.00
Height (cm)	1.00	1.00	1.00
Stride length (cm)	1.00	0.000*	0.000*
Step length (cm)	0.711	0.000*	0.000*
Step width (cm)	0.000*	0.000*	1.00
Cadence (Steps per minute)	0.000*	0.000*	0.000*
Velocity (m min^{-1})	0.000*	0.000*	0.000*
Hip ROM (degrees)	0.000*	0.000*	0.001*
Knee ROM (degrees)	0.000*	0.000*	0.001*
Ankle ROM (degrees)	0.000*	0.000*	0.000*

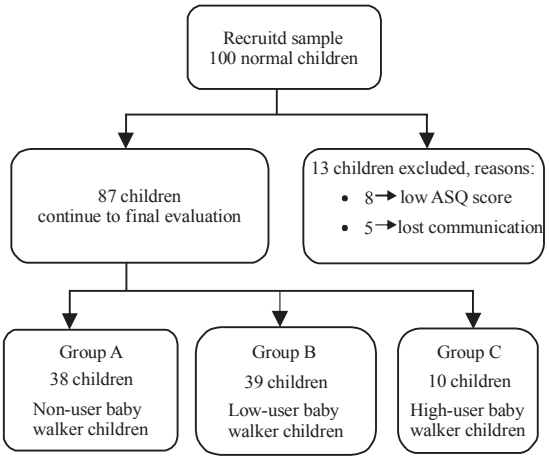

Fig. 1: Flow chart for the participants

DISCUSSION

From 87 children who participated in this study, 49 children used baby walker (bw) representing 56.3% of children that reflect high rate of bw usage in Egyptian population, also Shiva *et al*. (2010) found that the percentage of usage of baby walker in Iranian children was 54.5%.

Many studies around the world reported high rate usage of the baby walker. In urban population in Turkey Dogan *et al*. (2009) found that percentage of bw usage reached 75.4% and Garrett *et al*. (2002) found that 54% of children used bw in Ireland. Thein *et al*. (1997) reported 50% in the United Kingdom and Marcella and McDonald (1990) 70-90% in the United States.

After comparing the age of acquisition of independent walking in the three groups (A, B and C), the results showed statistically significant difference between A and B (with increase mean age values in B by 18 days than in A) and between A and C (with increase mean age values in C by 35 days than in A). These results can be attributed to the effect of using bw in delaying acquisition of independent walking in B and C (that were used walker) rather than in A who didn't use walker. This delay increased by increasing use of baby walker as in C (higher users) that delayed by 16 days than B (low users).

These results come in agreement with Garrett *et al*. (2002), who found that children used baby walker acquired motor milestones such as crawling, standing alone and walking alone at a later time than children who didn't use baby walker and added that there was a relationship between the amount of baby walker use and the extent of developmental delay.

These results are also supported by Siegel and Burton (1999), who concluded that the occluding-walker (New-style walkers didn't allow babies to see their legs) seems to have negative effects on the development of sitting and walking and see-feet walker (outdated walkers allow babies to see their legs) didn't promote motor development, also Kauffman and Ridenour (1977) founded that children who regularly used baby walker walked at a mean age of 382 days and children who didn't use this equipment walk at a mean age of 368 days with mean difference 14 days between both groups.

On the other hand, Shiva *et al*. (2010) reported that no significant difference was observed between the two groups (baby walker and non-baby walker) in terms of the age at which the infants start walking and also Chagas *et al*. (2011)

confirmed that the use of a baby walker did not influences the age of gait acquisition.

The weight and height of each child in the three groups (A, B and C) were recorded only once when applying gait analysis, the result was then treated statistically and showed non-significant statistical difference between the three groups which confirmed the homogeneity of all groups' samples in weight and height.

The results of the presented study showed significant difference in group C compared with the other groups (A and B) in stride length and step length variables, these differences increase in favor of A and B than C which reflect the negative impact of high uses of baby walker in decreasing these variables. Significant decrease in stride and step length founded in group C could be due to marked decrease of hip flexion which recorded in the same group during initial contact, but decrease the hip flexion which recorded also in group B during initial contact didn't affect the same variables (stride and step length) as it substituted with marked decrease in knee flexion.

Concerning with step width variable, result revealed significance differences of group A with the other groups (B and C), these significance reduction in favor of group (B and C) who used the baby walker. These finding could be due to the external support provided by walker which practices the children to walk with narrow base of support than their peers who didn't use the walker. According to Adolph (2002), the initial walking pattern is characterized by wide base of support during standing and walking with arm held in high guard position, as the child grow improving the stability and dynamic balance cause gradual decreasing in the base of support.

Comparison between all groups regarding cadences showed significant differences between groups with significant reduction in favor of group A who didn't use the walker. Increase cadence in group B and C who used the baby walker could be due to the wheels attached to the walker which allow child to take more steps per minute, but in fact the balance in this young age is not well developed to accommodate this high cadence so the result is repeated falling of the child.

According to Rose and Gamble (1994) cadence, the number of steps per minute, start out very high in first independent walking and that because the 1 year old child has less strength and stability in his hips so he spends a small amount of time in single limb stance compared to the adult. Consequently, the child take more steps per minute and spends less time in single limb support.

Differences in velocity between groups increase in favor of group (B) while, group (C) give the lowest velocity comparing with the others two groups these finding may be attributed to the direct proportion between velocity and both cadence and step length so increase cadence in group (B) improve the velocity than group (A) but in group (C) increasing cadence was came in conjunction with marked decrease in step length and that cause decreasing in velocity than other groups (A and B).

The current study results showed significance differences between all groups in hip and knee angles during initial contact, these significant increase in favor of group A than other groups (B and C), also the result revealed significant differences between all groups in ankle angle during initial contact which reduced in favor of group A. All these differences in gait pattern between groups which has always been in favor of non-user baby walker children (group A) may be attributed to the negative impact of using baby walker in changing the normal pattern of walking.

Detected differences among the groups (A, B and C) appear in most variables in favor of group (A) who didn't use the walker. These variables were "Stride length, step length, cadences, hip angle, knee angle and ankle angle". In one variable which was step width the differences was in favor of users of baby walker children groups (B and C) and concerning with velocity variable, differences come in favor of group (B) while group (C) was the worst.

Few researches were studied gait pattern differences between users and non-users of baby walker children and these research used different methods in their evaluation, some of these methods were subjective evaluation depending on the researcher observation which give a weak evidence about its findings.

Engelbert *et al.* (1999) studied two cases of children that after used baby walker showed motor pattern similar to spastic diaplegic and concluded that children used baby walker developed stiff-knee gait, a leaning forward of the trunk due to hip flexion and a decreased stride length, also the walker prevented the practice of equilibrium and protection reactions that should be developed. Kauffman and Ridenour (1977) also studied six pairs of fraternal twins males, one child in each pair used baby walker for total 2 h day^{-1} and the other child didn't use bw. Qualitative analysis of EMG traces revealed that the use of walker modified the mechanics of infants' locomotion in various aspects (muscle activation, joint positions, weight support, position of the center of mass and lateral displacement of body), the authors concluded that EMG analysis suggests an inappropriate gait pattern among the walker's users.

CONCLUSION

From the obtained results of this study supported by the relevant literature, it is possible to conclude that usage of baby walker can delay the acquisition of independent walking and disturb the normal gait pattern in normal children so it is highly recommended stopping baby walker usage and educate parents and health professionals about its hazards.

REFERENCES

Adolph, K.E., 2002. Learning to Keep Balance. In: Advances in Child Development and Behavior, Kail, R. (Ed.). Vol. 30, Elsevier Science, Amsterdam, pp: 1-40.

Australian Physiotherapy Association, 2007. Baby walkers. Position Statement, Australian Physiotherapy Association, Australia. http://www.physiotherapy.asn.au/DocumentsFolder/Advocacy_Position_Baby_Walkers_2007.pdf.

Beckett, C. and H. Taylor, 2010. Human Growth and Development. 2nd Edn., Sage Publication, USA., ISBN: 9781446248201, Pages: 232.

Burrows, P. and P. Griffiths, 2002. Do baby walkers delay onset of walking in young children? Br. J. Community Nurs., 7: 581-586.

Chagas, P.S.C., M.C. Mancini, M.G.A. Tirado, L. Megale and R. Sampaio, 2011. Beliefs about the use of baby walkers. Braz. J. Phys. Ther., 15: 303-309.

Crouchman, M., 1986. The effects of babywalkers on early locomotor development. Dev. Med. Child Neurol., 28: 757-761.

Dogan, D.G., M. Bilici, A.E. Yilmaz, F. Catal and N. Keles, 2009. Baby walkers: A perspective from Turkey. Acta Paediatr., 98: 1656-1660.

Engelbert, R.H.H., R. van Empelen, N.D. Scheurer, P.J.M. Helders and O. van Nieuwenhuizen, 1999. Influence of infant-walkers on motor development: Mimicking spastic diplegia? Eur. J. Paediatr. Neurol., 3: 273-275.

Garrett, M., A.M. McElroy and A. Staines, 2002. Locomotor milestones and babywalkers: Cross sectional study. Br. Med. J., Vol. 324. 10.1136/bmj.324.7352.1494

Health Canada, 2013. Injury data analysis leads to baby walker ban. http://www.hc-sc.gc.ca/sr-sr/activ/consprod/baby-bebe-eng.php.

Kauffman, I.B. and M. Ridenour, 1977. Influence of an infant walker on onset and quality of walking pattern of locomotion: An electromyographic investigation. Percept. Motor Skills, 45: 1323-1329.

Mack, K.A., J. Gilchrist and M.F. Ballesteros, 2008. Injuries among infants treated in emergency departments in the United States, 2001-2004. Pediatrics, 121: 930-937.

Marcella, S. and B. McDonald, 1990. The infant walker: An unappreciated household hazard. Connecticut Med., 54: 127-129.

Murphy, A. and A.J. Nicholson, 2011. Baby walkers in Europe-time to consider a ban. Irish Med. J., 104: 69-69.

Rose, J. and J. Gamble, 1994. Human Walking. 2nd Edn., Williams and Wilkins Inc., Baltimore, USA.

Shiva, F., F. Ghotbi and S.F. Yavari, 2010. The use of baby walkers in Iranian infants. Singapore Med. J., 51: 645-649.

Siegel, A.C. and R.V. Burton, 1999. Effects of baby walkers on motor and mental development in human infants. J. Dev. Behav. Pediatr., 20: 355-361.

Squires, J. and D.D. Bricker, 2009. Age and Stage Questionnaire: A Parental Completed Child Monitoring System. 3rd Edn., Paul H. Brookes Publishing Co., London, ISBN-13: 978-1598570021, Pages: 170.

Thein, M.M., J. Lee, V. Tay and S.L. Ling, 1997. Infant walker use, injuries and motor development. Injury Prevent., 3: 63-66.