

**THE ANALYSIS OF POSTURAL DYSFUNCTION OF CHILDREN WITH CEREBRAL  
PALSY IN ELEMENTARY SCHOOLS FROM THE OCCUPATIONAL THERAPY  
PERSPECTIVE**

DOI: 10.24234/SE.V8I1.20

**AUTHORS' DATA**

**Zaruhi Harutyunyan, PhD**

Lecturer, Chair of Speech and Rehabilitative Therapy

Khachatur Abovian Armenian State Pedagogical University, Republic of Armenia

Contact: [h.zaruhi@gmail.com](mailto:h.zaruhi@gmail.com)

**Anush Margaryan, MA in OT**

Occupational therapist

Regional pedagogical-psychological support center of Armavir, Republic of Armenia

Contact: [margaryan.anushik@inbox.ru](mailto:margaryan.anushik@inbox.ru)

**ABSTRACT**

The study aims to explore the influence of supportive and challenging factors of the educational environment on the positioning problems of children with Cerebral Palsy.

The study is based on qualitative methodology. Semi-structured interview and observation methods were used for data collection. An interview was conducted with 8 teachers working at the school and members of the pedagogical psychological team members, as well as difficulties in body structure and posture control were observed for 8 children having Cerebral Palsy. Data analysis of the study was carried out using the descriptive method.

The results of the research data analysis proved the important prerequisites for overcoming the problems concerned with maintaining the body structure and keeping posture control. Mostly the importance of supportive educational environmental factors was considered to be more significant.

Also, as an essential component had been identified the need for a personal assistant for the learners, the importance of supporting team members' positive attitude, and continuous training for the members of the pedagogical psychological team members. In addition, the need to use mutually agreed approaches and joint work was also vital for ensuring the effectiveness of rehabilitation work and having positive results.

**Keywords:** *cerebral palsy, positioning, posture control, educational environment, occupational therapy.*

## INTRODUCTION

It is well known that as a result of Cerebral Palsy (CP) a person's ability to carry out autonomous and independent living activities is limited and, in particular, difficulties in controlling purposeful movements and coordination are common to all children with CP (Graham, & Selber 2003). Since the control of body structure and having functional posture is an important prerequisite and basis for the realization of a person's daily activities, it is very important to study and evaluate the various difficulties of maintaining the body position of children with CP in their daily lives. According to various authors, positioning issues are tied and have a significant impact on the main components of a person's daily living in work (education), self-care and leisure activities (Reedman et al. 2019).

Body posture, as a chain of numerous conditional and unconditional reflexes, is essentially a dynamic stereotype, a kind of movement habit (Domagalska-Szopa, & Szopa, 2017). At the same time factors from the external environment also play an important role in the development of posture. Maintaining a stable posture, even during daily functional activities, is challenging because stability demands complex interactions between the sensory system, central nervous system, and muscle-skeletal system (Correa et al., 2007).

Considering the role of postural control in the performance of motor skills (Chen & Woollacott, 2007) and in the adaptation of an individual to changing environmental demands, it is important to understand how these factors interact with children with CP in an educational environment. Taking into account the characteristics of physical disorders of children with CP first of all, it is important to provide them with an accessible and supportive social and physical environment, which is an important prerequisite for engaging them in the educational process, in terms of controlling body structure and for overcoming positional problems (Polichino, Clark, & Chandler, 2005).

The use of rehabilitation intervention and, especially, Occupational Therapy (OT) intervention approaches are of particular importance for overcoming the problems of positioning children with CP in the educational environment (Law et al. 1996). In addition, the awareness of each professional working with them and the use of OT approaches to provide targeted support is essential. Moreover, knowing the advantages and disadvantages of methodological approaches and gaps in literature may guide the improvement of the quality of life of children with CP in the educational process. In this regard, this study aimed to explore the influence of supportive and challenging factors of the educational environment on the positioning problems of children with cerebral palsy.

## LITERATURE REVIEW

Based on the literature review, deficits in movement and postural control are defining characteristics of cerebral palsy. Since postural control is defined as the ability to align and adjust body

segments against gravity without falling or collapsing, it involves complex neural processes that must be coupled to biomechanical and environmental constraints and can be categorized in terms of static, active, and reactive control (Hemmingsson, Borell & Gustavsson, 2003). Because the ability to control posture is an integral part of all movement, deficits in the posture system contribute to challenges in body structure and function, daily activities, and participation. When a child has CP his/her performance of self-care skills is also limited: bathing, undressing and dressing, brushing teeth etc. When performing the above-mentioned activities, the children's bodies may be stretched or tense or very weak which makes it additional difficult to lift or move them, to ensure proper positioning (Shumway-Cook & Woollacott, 2011).

According to the International Classification of Functioning (ICF), changing and maintaining body position is defined as assuming or changing a position and moving from one place to another, such as turning from one side to another, sitting, standing and changing those positions (WHO, 2007). Accordingly, maintaining the position is one of the important prerequisites for the realization of a person's life activity, and in case of existing problems in body structure and trunk control, that can affect the important and main areas of a person's life activity, such as work, self-care and rest (Jones, & Gray, 2005). Analyzing the problems of maintaining the position and posture of children with CP and performing movements, it is necessary to highlight all the strategic approaches that are developed to carry out effective rehabilitation works to overcome the inability to maintain body position, balance and movement difficulties which are primary for the performance of life activities. Ensuring a functional position is the most important point in rehabilitation work with children with CP since that helps to prevent deformities and contractures, and promotes mobility and functionality in all areas of daily activities.

According to the studies carried out by specialists in the rehabilitation field, to effectively plan and effectively implement intervention works to overcome positioning problems, the Biomechanical and Neurodevelopmental frame of references are usually used, which are a clear guide when working with people with positioning problems (McMillan, 2011; Barthel, 2010). For school-aged children, being involved in the educational process is a significant activity but most children with CP have difficulty maintaining their posture in sitting or standing positions which prevents them from participating in the classroom process.

Some psychosocial characteristics of learners with CP associated with manifestations and effects of their disorders have an impact on environmental barriers, that relate to architectural accessibility, or barriers in the attitudes of the environment (De Villiers, 2015; Cologon, 2020). Taking into account the importance of the participation of each child in the educational process, today, in RA, it is important to provide environmental conditions adapted to the specifics of development for every child, including

those who have special educational needs, as well as ensuring the result defined by the state standard of general education. At present, inclusive education should be the first choice for most pupils with CP and similar types of disabilities.

Besides that due to the characteristics of the physical disorders of children with CP, first of all, it is important to provide them with an accessible and supportive social and physical environment, which is an important prerequisite for involving them in the educational process, by providing appropriate facilities. Physical difficulties are among the most common problems in children with positioning problems and involve multiple physical limitations, especially when moving around in a wheelchair, for children who have problems maintaining and changing their position, it is more important to have an accessible and supportive environment. The concept of "accessible environment" itself is used in a broad sense, including the accessibility of the school, the classroom, as well as the use of partial subjects in the learning process (Barnes, 1991).

Children with CP require intervention from varied disciplines across practice settings to optimize function throughout their lifespan. The management of a child with cerebral palsy, to optimize functional abilities, typically includes the input of many disciplines, including Occupational Therapy (Wilsdon, 1996). OT focuses on the development of skills necessary for the performance of activities of daily living that include play, self-care activities such as dressing, grooming and feeding, and one-motor tasks such as writing and drawing. Another aspect of OT is the adaptation of equipment and seating to allow better upper extremity use and to promote functional independence. By using multiple approaches and developing an appropriate assessment strategy (observation, interview), OT assesses the ability of children with difficulty maintaining and changing the position to be "engaged in any activity" in their social environment, in natural conditions, as well as in institutions where the learner realizes its educational and social activities (Spencer et al. 2006).

Considering that OT interventions in schools have drawn attention recently, and the fact that children with disability have the right to use educational opportunities like ordinary children planning the intervention individually for each learner can be more effective (Baum, & Christiansen, 2005). Ellsworth and Zhang (2007) highlighted the importance of OT intervention in the educational system that ensured the child's full participation in the educational process: following the class, maintaining the school schedule, being able to sit in class, being able to express wishes, communicating with classmates and the teacher.

Using a new paradigm in OT intervention, some therapists and researchers focused on functional success (Mahoney, Robinson, Perales, 2004; Colver, 2006), compensatory movements and environmental adaptations that may be more efficient solutions to facilitate participation of children with CP in daily activities (Howle, 2002).

In this regard, the study aimed to explore the influence of supportive and challenging factors of the educational environment on the positioning problems of children with cerebral palsy.

## METHODOLOGY

To carry out the research, the qualitative research method was chosen, and semi-structured interview and observation methods were used for research data collection. The interview was conducted with teachers working at the school and with pedagogical psychological team members (psychologist, speech therapist, special pedagogue, and typhoon educator).

8 children with CP who had difficulty in maintaining body structure and controlling posture were observed in their classrooms. In particular, a descriptive qualitative approach was used for data analysis, which enables to highlighting of the perception and viewpoint of the sample group regarding the given phenomenon (Nayar, & Stanley, 2015). The results of qualitative descriptive research were easily communicated to the researcher and provided an opportunity to understand the interpretation of the situation from the perspective of the respondents.

## PARTICIPANTS

The research participants were 8 children studying in primary school who had been diagnosed with CP, teachers, and psychological pedagogical team members (special pedagogue, psychologist, speech therapist) who were working with children with CP at the school. The following criteria were used for the selection of research participants:

- 8 children with CP studying in elementary school have problems maintaining their position and controlling their posture and have limited participation in the educational process.
- 8 specialists of the pedagogical and psychological support team working in schools, who have 4 or more years of work experience in the school.
- Elementary school teachers with 10 or more years of working experience.

## DATA COLLECTION

A semi-structured interview and observation were used for data collection, which were quite often used methods in qualitative research. Using a semi-structured interview helped me get the needed information about the topic under study. The structure of semi-structured interviews is considered the best way to gain deeper learning and make discoveries (Whiting, 2008). For the implementation of a semi-structured interview in this study, it was ensured that the interview environment was relaxed and supportive and that there were no people around who could influence the respondent's answers. All interviews were recorded and transcribed. Subsequently, the texts of the semi-structured interviews were

read, and coded and descriptive analysis was carried out.

Semi-structured interview questions were created based on the research question and a total of 8 questions were specified. The questions were aimed at discovering the ways of organizing rehabilitative intervention aimed at overcoming the positioning problems of children with CP studying in elementary schools. In total 8 children with CP who had difficulty maintaining posture and controlling posture were observed. Done observations helped more clearly describe and present existing difficulties and problems of children with CP in their educational environment.

All specialists were provided with an informed consent. The participants agreed to provide information for current research implementation by signing the informed consent which assured that the provided information would be anonymous and the results would be used in a generalized way.

### DATA ANALYSIS

The analysis of the research data was carried out based on the descriptive analysis method that involved a systematic observation of the object of the study and cataloguing of the observed information (Trochim & William 2006). The use of this method helped to obtain accurate data and describe the influence of supportive and challenging factors of the educational environment on the positioning problems of children with cerebral palsy. All interviews were recorded and a detailed analysis was performed.

### RESULTS/DISCUSSION

The analysis of the research results was aimed at studying the influence of supportive and challenging factors of the school environment on the positioning problems of children with cerebral palsy as well as to investigate the main factors that would enable participation of children with CP in educational activities. The analysis of the information provided by the research participants made it possible to identify and describe the main influence and challenging factors of the school environment, that hinder the process of overcoming the positioning problems of children with CP.

While summarizing the research results, almost all the participants confirmed that **not supportive physical environmental factors** were considered to be the major reason that emerged difficulty in keeping postural control for children with CP, which made an obstacle for learners to participate freely in the educational processes. According to the participants- mostly psychological-pedagogical team members stated that environmental factors had a direct connection and influence on the effectiveness of rehabilitation treatment for overcoming positioning problems at school. A supportive environment both physical and social could facilitate a child's participation in the educational process. Done observations also indicated the importance of environmental factors and proved that having not

comfortable and well-organized classrooms the effectiveness of participation in the educational process for children having postural dysfunction was decreased. Other researchers also stated that that child with CP needed effective support and optimal care along with education that may involve interaction by physical therapist, occupational therapist, speech-language therapist, special education teacher, adaptive sports therapist, nutritionist and other related supporters (Karande & Kulkarni, 2008).

Research participants especially emphasized the great need for an adapted desk and chair, which were not available in almost all schools. If in the schools there were not appropriate supportive furniture and environmental conditions that supported overcoming positioning problems and facilitated the learners' abilities to keep body structure in a proper position, so for these learners to participate freely and independently in the classroom process and other areas of school activities were almost not possible. Law et al. (2007) stated that cultural, economic, institutional, physical, social, and attitudinal factors in the environment could facilitate or hinder the participation of children with disabilities.

Children having postural problems set in uncomfortable school desks, therefore had difficulty controlling their body posture and had difficulty or not being able to maintain or change their body position while performing activities. Thus, the potential therapeutic role of the environment in promoting participation was illustrated by emerging environment-based approaches such as context therapy and the knowledge related to the effect of the environment on participation can contribute to the development of intervention plans and strategies used with children with CP (Darrah et al. 2011).

As a result of the study, the research participants emphasized the need for a **personal assistant** for these children who should always accompany them in the school environment. Accordingly, a personal assistant can always help the child, if necessary, move from the school entrance to the classroom or from the classroom to the bathroom, correct their posture and sitting position can support during activities that require physical movement, help with tasks, move and bring to the blackboard. Supports can be described as resources and strategies aiming to promote the development, education, interests and personal well-being of a person and to enhance individual functioning (American Association on Intellectual & Developmental Disabilities 2010).

According to the participants, the need for a personal assistant was mainly due to the unfavourable school environment, individual intervention and incomplete organization of rehabilitation works at schools and out of it. The need for a personal assistant who should always accompany the learner in the educational environment was significant in cases when the school did not provide with necessary and appropriate environmental conditions to overcome postural dysfunction and facilitate the learner's participation in educational processes (Thompson et al. 2009). Having a personal assistant was very important in the educational environment and allowed children to be involved in education with their peers as much as possible (Teaching Children With Disabilities in Inclusive Settings, UNESCO,

2009).

The other aspect of research data analysis highlighted the importance of the **positive attitude** of teachers and members of the pedagogical psychological team members and the role of support in the process of overcoming postural dysfunction problems for children with CP. According to the participants, a positive attitude can be an incentive for a child to attend school and overcome physical difficulties. Most children with spastic hemiplegia have normal cognitive function and positive attitude considered the most important given their education, employability and social life (Dunst et al. 2002).

The participants noted that children with CP due to a lack of possibilities for equal participation in the classroom process still experienced **isolation and limited opportunities** to be full members of the “*school society*”. In addition, children with CP also had difficulties with fine motor skills, cognition, concentration and maintenance which required additional intervention and support for them to be able to take part in classroom activities.

According to the participants, the continuous pieces of training organized for the members of the pedagogical psychological team members, teachers, and other professionals could be considered as a way to raise awareness of current issues and aimed at developing a mutual understanding of how to support children with postural dysfunction. Since postural problems play a central role in the motor dysfunction of children with CP, the performance of everyday activities was noticeably influenced by such postural deficits. At the same time apart from the severity of disability, it was also important the size of the support base, which influenced the child's possibility to control posture and maintain independence.

In this case, the cooperative work of the team members was important, and occupational therapy consultation had a great role in organizing rehabilitation work with children who had problems in maintaining position and posture in the school environment. In this context, pedagogical psychological teamwork where every specialist used to provide mutually agreed treatment to children with postural dysfunction could bring significant changes and positive results. Data analysis of this research emphasised the need for providing mutually agreed teamwork when specialists could jointly communicate, exchange ideas and work together to come up with solutions to problems. In overcoming postural dysfunction it was very important to work together with different specialists and to use mutually agreed approaches, which contributes to the effectiveness of rehabilitation work in terms of maintaining body structure and postural control (Canadian Association of Occupational Therapists, 2000). Though all team members may not be involved in direct service delivery all members could be involved in planning and monitoring aspects of intervention. The team worked together during the assessment and they also could share information and teach and learn across disciplines (Trabacca, et al. 2016).

According to the experts, it was especially important to use mutually agreed approaches, and



team discussions, which was the direction of the work carried out and ensure the effectiveness of the rehabilitation work. The participants of the research emphasized cooperation with the Occupational Therapists, frequently organizing video-practical works aimed at overcoming the problems of maintaining position and posture. Thus, as a result of the research, it was possible to identify the ways of overcoming the positioning problems of children with CP and to study the influence of the favorable and hindering factors of the educational environment in the presence of positioning problems of children with CP.

## CONCLUSION

Current research revealed the importance of supportive environmental factors for overcoming postural dysfunctions and highlighted the role of physical and social environments that could facilitate or hinder learners' participation in the educational processes.

The summary of the results of the conducted research made it possible to distinguish that supportive environmental conditions were important for overcoming the problems of maintaining postural problems and facilitating the participation of children with CP in educational activities. In general, the environment can be a facilitator or a barrier to participation and from this point of view, it was essential to consider those environmental factors that provided access, availability of resources, social support, and equality for children with CP.

The need for a personal assistant for the learners and the positive attitude of teachers and pedagogical psychological team members also were important prerequisites in the process of overcoming postural dysfunction. A good knowledge of CP predicts a positive attitude and the personal assistant should also be reliable, informative, alert, respectful, considerate and friendly. The other most important aspect in this instance was the continuous re-training and awareness of the members of the pedagogical psychological team members working in schools that would be aimed at providing innovative methods and approaches for overcoming postural dysfunction for children with CP in the educational settings.

## REFERENCE LIST

- American Association on Intellectual and Developmental Disabilities. (2010).** *Intellectual Disability: Definition, Classification, and Systems of Supports* (11th ed.). Washington, DC: Author.
- Barnes, K. J. (1991).** Modification of the physical environment. In C. Christiansen & C. Baum (Eds.), *Occupational Therapy: Overcoming Human Performance Deficits* (pp. 701–745).

Thorofare, NJ: Slack Inc.

- Barthel, K. A. (2010).** A frame of reference for neuro-developmental treatment. In P. Kramer & J. Hinojosa (Eds.), *Frames of Reference for Pediatric Occupational Therapy* (3rd ed., pp. 187-233).
- Baum, C. M., & Christiansen, C. H. (2005).** Person-environment-occupation-performance: An occupation-based framework for practice. In *Occupational Therapy: Performance, Participation, and Well-being* (3rd ed.).
- Canadian Association of Occupational Therapists. (2000).** *Enabling Occupation: An Occupational Therapy Perspective*. Ottawa, ON: CAOT Publications ACE.
- Chen, J., & Woollacott, H. (2007).** Lower extremity kinetics for balance control in children with cerebral palsy. *Journal of Motor Behavior*, 39(4), 306–316.
- Cologon, K. (2020).** Is inclusive education really for everyone? Family stories of children and young people labelled with 'severe and multiple' or 'profound' 'disabilities'. *Research Papers in Education*, 35(1), 1–23. <https://doi.org/10.1080/02671522.2020.1849372>
- Colver, A. (2006).** What are we trying to do for disabled children? *Current Paediatrics*, 16(6), 501-505.
- Correa, J., Correa, F., Franco, R., & Bigongiari, A. (2007).** Corporal oscillation during static biped posture in children with cerebral palsy. *Clinical Biomechanics*, 47, 131–136.
- Darrah, J., Law, M., Pollock, N., et al. (2011).** Context therapy: A new intervention approach for children with cerebral palsy. *Developmental Medicine & Child Neurology*, 53(6), 615–620. <https://doi.org/10.1111/j.1469-8749.2011.03959.x>
- De Villiers, A. J. (2015).** *Stories of School Reintegration Following Traumatic Brain Injury (TBI): The Experiences of Children, Their Primary Caregivers and Educators in the Western Cape* [Master's thesis, University of Cape Town]. <http://hdl.handle.net/11427/15500>
- Domagalska-Szopa, M., & Szopa, A. (2017).** Postural orientation and standing postural alignment in ambulant children with bilateral cerebral palsy. *Clinical Biomechanics*, 6, 22–27.
- Dunst, C., Hamby, D., Trivette, C., Raab, M., & Bruder, M. (2002).** Young children's participation in everyday family and community activities. *Psychological Reports*, 91(3, Pt 1), 875–897.
- Ellsworth, N., & Zhang, C. (2007).** Progress and challenges in China's special education development. *Remedial and Special Education*, 28(1), 58–64.
- Graham, H., & Selber, P. (2003).** Musculoskeletal aspects of cerebral palsy. *The Journal of Bone and Joint Surgery*, 85, 152–166.
- Hemmingsson, H., Borell, L., & Gustavsson, A. (2003).** Participation in school: School assistants creating opportunities and obstacles for pupils with disabilities. *OTJR: Occupation*,

*Participation and Health*, 23(3), 88–98.

- Howle, J. (2002).** *Neurodevelopmental Treatment Approach: Theoretical Foundations and Principles of Clinical Practice*. Laguna Beach, CA: Neurodevelopmental Treatment Association.
- Jones, M., & Gray, S. (2005).** Assistive technology: Positioning and mobility. In S. K. Effgen (Ed.), *Meeting the Physical Therapy Needs of Children*. Philadelphia: FA Davis Company.
- Karande, S., & Kulkarni, M. (2008).** Impact of an educational programme on parental knowledge of cerebral palsy. *Indian Journal of Paediatrics*, 75(9), 901-906.
- Law, M., Cooper, B. A., Strong, S., Stewart, D., Rigby, P., & Letts, L. (1996).** The person-environment-occupation model: A transactive approach to occupational performance. *Canadian Journal of Occupational Therapy*, 63, 9-23.
- Law, M., Petrenchik, T., King, G., & Hurley, P. (2007).** Perceived environmental barriers to recreational, community, and school participation for children and youth with physical disabilities. *Archives of Physical Medicine and Rehabilitation*, 88(12), 1636-1642.  
<https://doi.org/10.1016/j.apmr.2007.07.035>
- Mahoney, G., Robinson, C., & Perales, F. (2004).** Early motor intervention: The need for new treatment paradigms. *Infants & Young Children*, 17, 291-300.
- McMillan, I. R. (2011).** The biomechanical frame of reference in occupational therapy. In E. A. S. Duncan (Ed.), *Foundations for Practice in Occupational Therapy* (5th ed., pp. 179-194).
- Nayar, S., & Stanley, M. (2015).** *Qualitative Research Methodologies for Occupational Science and Therapy*. Routledge, Taylor & Francis Group.
- Polichino, J., Florek Clark, G., & Chandler, B. (2005).** Meeting sensory needs at school: Supporting students in the natural environment. *OT Practice*, 10(14), 12-15.
- Reedman, S. E., Boyd, R. N., Trost, S. G., Elliott, C., & Sakzewski, L. (2019).** Efficacy of participation-focused therapy on performance of physical activity participation goals and habitual physical activity in children with cerebral palsy: A randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, 100(4), 676-686.  
<https://doi.org/10.1016/j.apmr.2018.11.012>
- Shumway-Cook, A., & Woollacott, M. (2011).** *Motor Control: Translating Research into Clinical Practice*. Baltimore: Lippincott Williams & Wilkins.
- Spencer, K. C., Turkett, A., Vaughan, R., & Koenig, S. (2006).** School-based practice patterns: A survey of occupational therapists in Colorado. *American Journal of Occupational Therapy*, 60(1), 81-91.
- Thompson, J. R., Bradley, V. J., Buntinx, W. H. E., Schalock, R. L., et al. (2009).** Conceptualizing

supports and the support needs of people with intellectual disability. *Intellectual and Developmental Disabilities*, 47, 135–146.

**Trabacca, A., Vespino, T., Di Liddo, A., & Russo, L. (2016).** Multidisciplinary rehabilitation for patients with cerebral palsy: Improving long-term care. *Journal of Multidisciplinary Healthcare*, 9, 455.

**Trochim, W. M. K. (2006).** Descriptive statistics. In *Research Methods Knowledge Base*. Retrieved March 14, 2011, from <http://www.socialresearchmethods.net/kb/statdesc.php>

**UNESCO Bangkok. (2009).** *Teaching Children With Disabilities in Inclusive Settings*. Bangkok: UNESCO Bangkok.

**Whiting, L. S. (2008).** Semi-structured interviews: Guidance for novice researchers. *Nursing Standard*, 22(23), 35-40.

**Wilsdon, J. (1996).** Cerebral palsy. In A. Turner, M. Foster, & S. E. Johnson (Eds.), *Occupational Therapy and Physical Dysfunction* (pp. 395–432). New York: Churchill Livingstone.

**World Health Organization. (2007).** *International Classification of Functioning, Disability and Health: Children and Youth Version: ICF-CY*. Geneva: World Health Organization.

*The article submitted and sent to review: 10.01.2024*

*Accepted for publication: 17.03.2024*



*This work is licensed under a Creative Commons Attribution-Noncommercial 4.0 International License.*