# CERTIFICATE OF ATTENDANCE

## SURABAYA INTERNATIONAL PHYSIOLOGY SEMINAR (SIPS)

Dr. Agus Hariyanto, M.Kes.

As : Speaker

**Hotel Ibis Surabaya City Center, 12th - 14th October 2017**

Dean
Faculty of Medicine
Universitas Airlangga

Prof. Dr. Soetojo, dr.,Sp.U(K)

Chairman of Committee
Surabaya International Physiology
Seminar and Workshop

Dr. Bambang Purwanto, dr.,M.Kes

**SK PB IDI No.: 01576/PB/A.4/10/2017**
**Participant : 10 SKP ; Speaker : 12 SKP ; Moderator : 4 SKP ; Committee : 2 SKP**

SIPS 2017

SURABAYA INTERNATIONAL PHYSIOLOGY SEMINAR

# PROCEEDINGS OF THE SURABAYA INTERNATIONAL PHYSIOLOGY SEMINAR

Surabaya, October 12-14, 2017


**Editors:**

Soetjipto
Muhammad Miftahussurur
Ferry Efendi
Purwo Sri Rejeki
Bambang Purwanto



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# SIPS 2017

Proceedings of the
Surabaya International Physiology Seminar

Surabaya - Indonesia

October 12 - 14, 2017

Edited by Soetjipto, Muhammad Miftahussurrur, Ferry Efendi, Purwo Sri Rejeki and Bambang Purwanto

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# BRIEF CONTENTS

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Malaysia

**Daniel John Green**
University of Western Australia
Australia

**Fadzil Hamzah**
Sport Center of Changi General Hospital
Singapore

**Deanne Helena Skelly**
Griffith University
Australia

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Daniel John Green, University of Western Australia, Australia
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# FOREWORD

## Dean of Faculty of Medicine, Universitas Airlangga

Assalamu'alaikum Wr. Wb.

Distinguished Guests, all the Participants, Ladies and Gentlemen

On behalf of Faculty of Medicine, Universitas Airlangga, it is my great pleasure to welcome all the speakers, moderators, and participants on **Surabaya International Physiology Seminar 2017 (SIPS 2017)**, which will be held from today, October 12th until October 14th, 2017. I would like to express my hearty welcome to all the international speakers, **Prof. Cheng Hwee Ming**, from University of Malaya, Malaysia; **Prof. Daniel John Green**, from University of Western Australia; **Dr. Fadzil Hamzah**, from Sport Center of Changi General Hospital, Singapore and **Dr. Deanne Helena Skelly**, from Griffith University, Australia.

The aim of SIPS 2017 is to provide a platform for academicians, educators, researchers, practitioners, undergraduate and postgraduate students to share and discuss the knowledge of the recent issues, opinions, researchers about the development and innovation of physiology in medical science, dentistry, veterinary, plants and agriculture, sports and sciences.

I believe this event is a great purpose in order to develop knowledge, experiences and best practices that can be applied for the good, especially in the field of healthcare as a whole.

Finally, I would like to express my sincere acknowledgements to those who take part and especially for Department of Medical Physiology, Faculty of Medicine, Universitas Airlangga for their effort in holding this event and wishing all to have success.

Wassalamu'alaikum Wr. Wb.

**Prof. Dr. Soetojo, MD.**
Faculty of Medicine, Universitas Airlangga

## Chair of Committee / Head of Physiology Department, Faculty of Medicine, Universitas Airlangga

Assalamu ‘alaikum Wr. Wb

Greetings,

On behalf of SIPS committee and Physiology Department, Universitas Airlangga, we are welcoming to Surabaya, City of Heroes.

This year, the annual meeting of Indonesian Physiology Society (IAIFI) is hosted at Surabaya, entitled **“Surabaya International Physiology Seminar Workshop (SIPS)”**. We present some update workshop and lectures in order to bring physiology research from basic to clinical application on humanities, animal welfare and good environment. All participants have opportunities to publish their research in presentation, poster and ISBN proceeding. Selected papers will be submitted to SCOPUS indexed proceeding/ journal and awarded as Best Poster and Best Oral Presentation.

We hope that all participants will get some interesting experiences for next 3 days, 12-14 October 2017. Enjoy our lectures and workshops, taste the culinary and take your time to sightseeing around Surabaya.

Wassalamu ‘alaikum wr. wb.

**Dr. Bambang Purwanto**
Chairman of Committee / Head of Physiology Department
Faculty of Medicine, Universitas Airlangga

## Welcome Address - Surabaya International Physiology Seminar  Workshop (SIPS)

Dear fellow Physiologists and Participants,

On Behalf of the Indonesian Physiological Society (IAIFI) and the Physiology Department Faculty of Medicine Universitas Airlangga, I would like to welcome you all to Surabaya International Physiology Seminar (SIPS), held on 12-14 of October 2017.

Finally after long-awaited Surabaya gets a turn again to host and organize the International Physiology Seminar. Hence the Steering– and Organizing Committee consisting of young energic physiologists are determined to make the Seminar a successful one. The theme of the seminar is:

***"The Role of Physiology in Translation Research: From Basic to Application"***

This annual meeting covers a wide range of topics of Physiology on Medicine, Dentistry, Veterinary, Plants and Agriculture, Sports and Sciences. We sincerely hope that SIPS 2017 enable to provide a platform for academicians, educators, researchers, practitioners and postgraduate students to present and discuss researches, development and innovations in wide range of topics as mentioned above. It will provide all participants to share knowledge, exchange new ideas and their experiences in many research topics, for then it will enhance future collaborations.

With great interest and enthusiasm I look towards the success of this Seminar, and wish all of you every success and a pleasant stay in Surabaya.

May Allah Swt. bestow upon us His Blessings.

On Behalf of the Steering and Organizing Committee Senior Physiologist,
**Prof. R. Soedarso Djojonegoro**

# CONTENTS

## PAPERS

### FULL PAPERS

# Bone Age Estimates the Onset of the Adolescent Growth Spurt Among Male Basketball Players

Sundari Indah Wiyasihati[1], Bambang Purwanto[1] and Agus Hariyanto[2]
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Keywords: Adolescent Growth Spurt, Bone Age, Growth Hormone, Maturation, Ossification.

Abstract: The adolescent growth spurt is an essential phase in human growth and development. Although inaccurate, parents, teachers, and coaches commonly use chronological age to estimate the onset of the adolescent growth spurt. Compared to chronological age, the bone age method is an easy, less-invasive alternative to estimate the onset of the adolescent growth spurt. Using the bone age method, this study aimed to investigate the onset of the adolescent growth spurt among male basketball players. The subjects were 23 healthy male volunteers from under-14 (U-14) and under-16 (U-16) basketball teams. The measurements of bone age were made with anteroposterior (AP view) wrist X-rays. The U-14 subjects' bone age was seven months older than their chronological age. The subjects who were experiencing an ongoing adolescent growth spurt were 7 cm taller than the late-onset subjects were. Bone age is more effective in assessing an ongoing adolescent growth spurt than chronological age is. An early-onset adolescent growth spurt resulted in taller height than a late-onset adolescent growth spurt did.

## 1 INTRODUCTION

A growth spurt is a distinct phase of physical growth corresponding with dramatic increases in height. After birth, there are two phases of growth spurts: the juvenile or mid-growth spurt and the adolescent growth spurt. While the juvenile growth spurt occurs at a relatively similar age for all individuals, the adolescent growth spurt varies in timing and is difficult to estimate (Cameron 2012).

The upper part of the human body grows rapidly during the first five years of age, whereas the lower part of the body grows swiftly after entering the maturation phase towards adulthood. The maturation phase is characterized by the alteration of diet patterns, physical activity patterns, and hormonal patterns. Teenagers experiencing an ongoing adolescent growth spurt consume more food and feel hungry more easily. In addition, these teenagers are very active but less easily fatigued. All these alterations are the effects of a growth hormone (GH) surge on the epiphyseal plates, beta pancreas, and muscles (Tanner 1981; Cameron 2012).

The GH surge results from a positive feedback mechanism from the testicular male hormone. The mature testes produce the male reproductive hormone: testosterone. Testosterone then stimulates the hypothalamus and anterior pituitary gland to produce a high concentration of GH (Foss et al. 1998).

GH and testosterone surges stimulate the early phase of the adolescent growth spurt. Both GH and testosterone surges are difficult to identify using routine laboratory examination. Serial blood collection with an invasive method is needed (Perinetti & Contardo 2016). Studies have explored some less-invasive alternative methods to determine growth spurts among teenagers (Pena & Mayorga 2016; Lai et al. 2008; Soegiharto et al. 2008; Lopes et al. 2016). One of them is bone age estimation, which uses X-rays to analyze the ossification of the bones of the hand. This study aimed to analyze some characteristics of the adolescent growth spurt among male basketball players using X-rays of hand ossification.



Indah Wiyasihati, S., Purwanto, B. and Hariyanto, A.
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# 2 METHODS

## 2.1 Subjects

The subjects were 23 healthy male teenagers who were aged 13–16 years old and who were members of the basketball club CLS Knights Surabaya. The subjects were divided based on chronological age for the basketball competitions: the under-14 (U-14) team, which consisted of 13 participants, and the under-16 (U-16) team, which consisted of ten participants. All subjects, coaches, and parents were informed of the purposes and measurements of the experiments. All subjects voluntarily joined the experiment with the permission of their parents.

## 2.2 Examination

The subjects' bone ages were examined using anteroposterior (AP view) left wrist X-rays to evaluate the ossification of the bones of the hand. Body height (cm) was measured using an anthropometer. The bone age data was then compared with the chronological age data from the subjects' ID cards and school reports. We categorized the subjects based on bone age versus chronological age on a crosstab. There were two categories in each team: ongoing growth spurt subjects (chronological age < bone age) and late-onset growth spurt subjects (chronological age > bone age) (Cobley et al. 2009). We then compared the subjects' heights among the categories.

# 3 RESULTS

We found a significant difference between chronological age and bone age only for the U-14 basketball team. Bone age was estimated to be seven months older than chronological age (Table 1).

Table 1: Comparison of chronological age and bone age for the U-14 and U-16 basketball teams.

| | Method | N | Mean of age (years) | Std. deviation | p |
|---|---|---|---|---|---|
| U-14 team | Chronological age | 13 | 13.62 | .51 | 0.022* |
| | Bone age | 10 | 14.20 | .63 | |
| U-16 team | Chronological age | 10 | 15.10 | .58 | 0.394 |
| | Bone age | 10 | 14.50 | 1.30 | |

* Significant at $p<0.05$

Bone age showed hand ossification as the mark of an ongoing adolescent growth spurt. Bone age identification was used to distinguish the ongoing adolescent growth spurt category and the late-onset adolescent growth spurt category. Subjects who had chronological ages younger than their bone ages were categorized into the ongoing adolescent growth spurt group. Subjects who had chronological ages older than their bone ages were categorized into the late-onset adolescent growth spurt group (Table 2).

Table 2: Crosstab of adolescent growth spurt phases of the U-14 and U-16 basketball teams.

| | | Adolescent growth spurt | | Total |
|---|---|---|---|---|
| | | Ongoing | Late onset | |
| Basketball team | U-14 | 9 | 4 | 13 |
| | U-16 | 4 | 6 | 10 |
| Total | | 13 | 10 | 23 |

There were nine subjects in the U-14 basketball team who were categorized into the ongoing adolescent growth spurt group. The subjects in the ongoing growth spurt group had grown faster than the late-onset subjects had. The results of the height measurements confirmed that they were ±7 cm taller (Table 3).

Table 3: Comparison of height between ongoing adolescent growth spurt subjects and late-onset adolescent growth spurt subjects in the U-14 basketball team.

| Adolescent growth spurt | N | Mean of height (cm) | Std. deviation | p |
|---|---|---|---|---|
| Ongoing subjects | 9 | 174.00 | 5.97 | 0.03 |
| Late-onset subjects | 4 | 167.67 | 5.81 | |

# 4 DISCUSSION

Bone age can be estimated using X-ray examination of hand ossification (Lai et al. 2008). The human hand consists of 27 "puzzle" bones. It supports muscle contraction for hand movement. These bones are separated from each other by cartilage tissue on the tips. During the maturation phase, the cartilage will be replaced by hard, mineralized bone in a process known as ossification. The ossification of cartilage is stimulated by GH (Soegiharto et al. 2008).

GH stimulation is increased during the adolescent growth spurt. The pituitary gland secretes GH into the bloodstream and stimulates its receptors at periphery. This GH surge is induced by GH-releasing factor, which is released from the

hypothalamus. During the ongoing adolescent growth spurt in males, testosterone stimulates the hypothalamus constitutively to release GH-releasing factor (Foss et al. 1998).

Testosterone is the most important male reproductive hormone. This anabolic steroid hormone is produced and released from mature testicular organs. Sexual maturation is the key factor to initiate the adolescent growth spurt. Early sexual maturation initiates early onset of the adolescent growth spurt. Likewise, late sexual maturation initiates late onset of the adolescent growth spurt (Foss et al. 1998; Cameron 2012).

Early onset of the growth spurt stimulates high-speed growth at the beginning of the adolescent phase. It was beneficial for the U-14 basketball team to reach their optimal height. Additionally, it favors other physical performance aspects, for example speed, strength, and endurance (Balyi & Way 2005), which are particularly crucial in order to play basketball games competitively (Canada Basketball Association 2008). Unfortunately, this study did not evaluate the physical performance of the U-14 basketball team. Further research is needed to confirm our findings using a physical performance assessment.

Early onset of the adolescent growth spurt gave a longer period for the U-14 subjects to grow and develop than the late-onset subjects. Nevertheless, the late-onset subjects had an equal chance to reach the ideal height at the end of the growth spurt phase. The late-onset subjects accelerated in growth and development due to their shorter periods to grow (Balyi & Way 2005).

The body needs an adequate amount of nutrition, physical stimulation, and rest during the adolescent growth spurt period. Teenagers tend to get hungry more easily and tend to engage in outdoor activities with their friends. Thus, their body metabolism will be increased to cater to the needs of the rapid physical growth and to provide energy to support activities (Canada Basketball Association 2008).

Parents, teachers, and coaches should observe and anticipate this period wisely. Teenagers in the growth spurt period should be given good nutrition in the proper amounts. Each meal should be balanced, consisting not only of proteins, carbohydrates, and fats but also of vitamins and minerals. Vitamin D and calcium are involved in the ossification of bones and hence are essential micronutrients needed to support growth spurts (Tanner 1981).

# 5 CONCLUSIONS

Bone age is more effective than chronological age in estimating the onset of the adolescent growth spurt. Early onset of the adolescent growth spurt resulted in taller height than late onset of the adolescent growth spurt did.

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