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

SDM
ELSEVIER
PT PELINDO HUSADA CITRA
RS PHC SURABAYA
Gestrindo
SCITEPRESS DIGITAL LIBRARY

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

Printed in Portugal
ISSN: 2184-3678
ISBN: 978-989-758-340-7
Depósito Legal: 446682/18

http://sipsfk.conference.unair.ac.id
sipsiaifi2017@gmail.com

BRIEF CONTENTS

INVITED SPEAKERS

Cheng Hwee Ming
University of Malaya
Malaysia

Daniel John Green
University of Western Australia
Australia

Fadzil Hamzah
Sport Center of Changi General Hospital
Singapore

Deanne Helena Skelly
Griffith University
Australia

ORGANIZING COMMITTEES

SCIENTIFIC COMMITTEE

Cheng Hwee Ming, Department of Physiology, Faculty of Medicine, University of Malaya, Malaysia
Daniel John Green, University of Western Australia, Australia
Fadzil Hamzah, Changi Sports Medicine Centre, Changi General Hospital, Singapore
Deanne Helena Skelly, University of Western Australia, Australia
R. Soedarso Djojonegoro, Universitas Airlangga, Indonesia
Paulus Liben, Universitas Airlangga, Indonesia
Elyana Asnar STP, Universitas Airlangga, Indonesia
Choesnan Effendi, Universitas Airlangga, Indonesia
Harlina, Universitas Airlangga, Indonesia
Tjitra Wardani, Universitas Airlangga, Indonesia
Gadis Meinar Sari, Universitas Airlangga, Indonesia
Purwo Sri Rejeki, Universitas Airlangga, Indonesia
Lilik Herawati, Universitas Airlangga, Indonesia
Bambang Purwanto, Universitas Airlangga, Indonesia
Kristanti Wanito Wigati, Universitas Airlangga, Indonesia
Hayuris Kinandita Setiawan, Universitas Airlangga, Indonesia
Irfiansyah Irwadi, Universitas Airlangga, Indonesia
Sundari Indah Wiyasihati, Universitas Airlangga, Indonesia
Eka Arum Cahyaning Putri, Universitas Airlangga, Indonesia
Misbakhul Munir, Universitas Airlangga, Indonesia

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

Non-Invasive Method on Slow-Twitch Quadriceps Muscle Fibers Dominate a High Level of Fitness

Yuannita Ika Putri[1], Andre Triadi Desnantyo[2] and Lilik Herawati[3]
[1]*Medical Program, Faculty of Medicine, Universitas Airlangga, Jl. Mayjend Prof Dr Moestopo, Surabaya, Indonesia*
[2]*Department of Orthopedics, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
[3]*Department of Physiology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
lilik_heraw@fk.unair.ac.id

Keywords: Fitness Level, Muscle Fiber Type, Non-Invasive Method, VO_2max.

Abstract: Previous studies have proved that there is a linear correlation between VO_2max and slow-twitch fibers in athletes. These studies were done using biopsy, the invasive method, to estimate the muscle fiber type. There is also a non-invasive method, which is convenient to use and not conflicted by ethical law in Indonesia. However, further study regarding muscle fiber shifting and its correlation with the level of fitness using a non-invasive method to estimate muscle fiber is still lacking. This research aims to determine the distribution and correlation between level of fitness and muscle fiber type in non-athletes estimated by a non-invasive method. Muscle fiber type in the quadriceps muscle group and level of fitness were determined in 33 untrained male students with an average age of 20.5 y.o. Muscle fiber type was determined by a non-invasive method by counting the maximal repetition with 80% 1RM weight. The level of fitness was determined a week later by the *Astrand ergocycle* method. The slow-twitch muscle fibers dominated a high fitness level (p=0.002). However, the correlation test between muscle fiber types and fitness level was not significant (p=0.551). This result showed that a high fitness level, which has a higher oxygen consumption, has numerous slow-twitch muscle fibers. It is rich in myoglobin delivering oxygen to maintain the aerobic activity. Yet there is no correlation between the level of fitness and muscle fiber type as estimated by a non-invasive method in quadriceps. Further studies are needed to analyze several factors that may contribute to it.

1 INTRODUCTION

Physical fitness has a direct relationship with the aerobic energy system, muscle ATP-PC capacities, and lactate metabolism (Robergs, 2003). Physical fitness can be determined by measuring VO_2max or maximal oxygen uptake (Ganong, 2010). VO_2max reflects the maximal amount of oxygen that has been consumed during intense physical activity.

Muscle fiber has been classified into slow-twitch (Type I) fiber and fast-twitch (Type II) fiber (Scott et al., 2001). The term mixed-twitch fiber has been used if there is an equal proportion of slow-twitch type and fast-twitch type in one muscle group. Slow-twitch fibers have a greater aerobic capacity, larger vascular and capillary, and are more resistant to fatigue than fast-twitch fibers (Ganong, 2010). Fast-twitch muscle was used for power and speed events due to its anaerobic capacity (Berning and Steen, 2005). Skeletal muscle consists of muscle tissues which can easily adapt due to the environment that change its constituent protein (Magaudda et al., 2004).

Several studies show that shifts in muscle fiber from fast-twitch fiber to slow-twitch fiber is possible due to long periods of endurance type events (Wilson et al., 2012). Athletes who are involved in long periods of endurance training have very high levels of VO_2max (Skinner, 2005) and a high percentage of slow-twitch fibers (Plowman, 2007). A previous study has proved that there is a linear correlation between VO_2max and slow-twitch fibers in athletes (Bergh et al., 1978). However, most of the research was carried out on athletes or trained men. Further study regarding muscle fiber shifting and its correlation with level of fitness in non-athletes and untrained men is still lacking. Moreover, a non-invasive method to identify muscle fiber type is still clearly unknown. The purpose of this study was to determine the distribution and

Ika Putri, Y., Triadi Desnantyo, A. and Herawati, L.
Non-Invasive Method on Slow-Twitch Quadriceps Muscle Fibers Dominate a High Level of Fitness.
In *Proceedings of Surabaya International Physiology Seminar (SIPS 2017)*, pages 182-185
ISBN: 978-989-758-340-7

correlation between level of fitness and muscle fiber type in non-athletes estimated by non-invasive method.

2 MATERIALS AND METHOD

Thirty-three untrained males aged 19–22 years participated in this study. Muscle fiber type in the *quadriceps* muscle group was determined by counting maximal repetition with 80% 1 RM weight during leg extension. This method is introduced and applied in muscle groups, not to an individual muscle (Kraps, 2001). Maximal repetition at a predetermined load and muscle fiber type have a fair to moderate relationship (Douris et al., 2006).

Level of fitness was determined using the *Astrand* method to measure predictive value of VO_2max while using the ergocycle. The *Astrand* method has been proven to be accurate in determining VO_2max in healthy young men and women (Hoehn et al., 2015). Then, the VO_2max was classified in low, average, high, and very high levels of fitness.

3 RESULTS

Frequency distribution of muscle fiber type of quadriceps muscle group among participants is presented at Fig. 1. Fifty-five percent participants have slow-twitch fibers, 39% mixed-twitch fibers, and 6% slow-twitch fibers. Frequency distribution of level of fitness among participants is presented at Fig. 2 where 21.2% participants have low level of fitness, 30.3% average, 33.3% high, and 15.2% very high.

The slow-twitch muscle fibers dominate low levels and high levels of fitness. There were five participants with slow-twitch and two participants with mixed-twitch muscle fibers at a low fitness level. In the high level of fitness, there were seven participants with slow-twitch and four participants with mixed-twitch muscle fibers. However, the significant difference between slow-twitch and mixed-twitch muscle fibers ($p=0.002$) was only in high level of fitness The participants with average level fitness were dominated by mixed-twitch muscle fibers, yet there was no significant difference. The fast-twitch muscle fiber type was detected in a small proportion ($p \geq 0.05$) on average and a very high level of fitness. The frequency of distribution based on classification of fitness level and muscle fiber type of participants is presented in Fig 3.

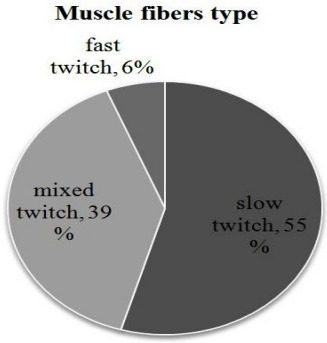

Figure 1: Frequency distribution of muscle fiber type of quadriceps muscle group (n=33).

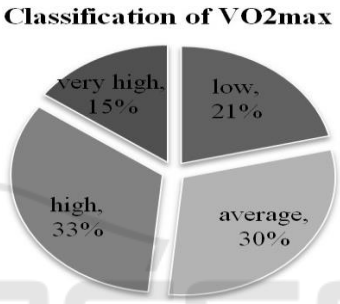

Figure 2: Frequency distribution of level of fitness (n=33).

P value was determined by the *Spearman* correlation test; $p = 0.551$ showed that there was no correlation between level of fitness and muscle fiber type (Table 1).

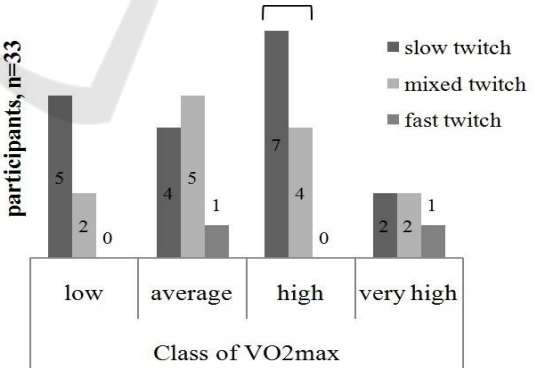

Figure 3: Frequency distribution of level of fitness on muscle fiber type.

*significant difference ($p<0.05$)) between slow and mixed-twitch muscle fibers.

Table 1. Correlation between level of fitness and muscle fiber type.

Spearman rho n=33	Classification of VO_2max	
Muscle fiber types	Correlation Coefficient	0.108
	Sig. (2-tailed)	0.551

4 DISCUSSION

The main finding in this study was that there is a significant difference between slow and mixed-twitch muscle fibers at a high level of fitness; however, there is no correlation between muscle fiber type and level of fitness in quadriceps of non-athletic young men. The domination of slow-twitch muscle fibers at a low and high fitness level is similar to the research by Barstow et al. (2000). Nine healthy participants were measured muscle fiber type recruitment based on the exercise intensity. The type I muscle (slow-twitch muscle fibers) was dominant in the low and/or high intensity of exercise (Barstow et al., 2000). Nevertheless, the correlation is contrary to the research from Barstow et al. (2000) and Bergh et al. (1978). One has to keep in mind that this study was done on untrained young men while their observation was done on athletes and trained men. Moreover, this study only uses *quadriceps* muscle to determine the muscle fiber type whereas the distribution between muscle fiber type varies in each muscle group.

There are some other factors that can influence level of fitness. Oxygen delivery is a primary factor in VO_2max limitation during exercises (Bassett and Howley, 2000). While athletes who have higher VO_2max also have a high percentage of slow-twitch fibers, VO_2max is not limited by the percentage of slow twitch muscle that someone is born with (Foss and Keteyian, 1998). Bergh's observation also found that VO_2max is higher in athletes than non-athletes in slow twitch fibers. This indicates that training and physical activities also influence VO_2max. Furthermore, studies regarding shift of muscle fiber from fast-twitch to slow twitch that was induced by training are still conflicted. It have already been cleared is muscle have the ability to alter its structural and functional properties to adapt to the environmental conditions imposed on it is known as muscle plasticity (Gransee et al., 2012). The mitogen-activated protein kinase signaling has been the possible pathway involved in exercise-induced adaptations in skeletal muscle (Hawley, 2002). Endurance exercise training can allegedly induce adaptive muscle fiber transformation and increase mitochondrial biogenesis (Wang et al., 2004). However, the endurance training procedure and period that can actually change the fast-twitch fiber to slow-twitch fiber are still being debated. The majority of evidence still suggests that cross-innervation is the only way to effectively change the fast-twitch fiber into a slow-twitch fiber (Foss and Keteyian, 1998).

5 CONCLUSION

In summary, a high level of fitness has slow-twitch muscle fibers type domination with the invasive method; however, the correlation between the level of fitness and muscle fiber type in quadriceps of young men has not been found in this study. Many other factors can influence level of fitness and muscle fiber type distribution. Factors and metabolic change pathways as well as the training procedure and period that can actually change the muscle fiber type from fast-twitch to slow-twitch are suggested as potential for further studies.

REFERENCES

Barstow, T.J., Jones, a M., Nguyen, P.H., Casaburi, R., 2000. Influence of muscle fibre type and fitness on the oxygen uptake/power output slope during incremental exercise in humans. Exp. Physiol. 85, 109–116.

Bassett, D., Howley, E., 2000. Limiting Factors for Maximum Oxygen Uptake and Determinants of Endurance Performance. Med. Sci. Sport. Exerc. 32, 70–84.

Bergh, U., Thorstensson, A., Sjodin, B., Hulten, B., Piehl, K., Karlsson, J., 1978. Maximal oxygen uptake and muscle fiber types in trained and untrained humans. Med. Sci. Sport 10, 151–4.

Berning, J., Steen, S., 2005. Nutrition for Sport and Exercise, 2nd ed. Jones and Bartlett Publishers, Massachusetts.

Douris, P.C., White, B.P., Cullen, R.R., Keltz, W.E., Meli, J., Mondiello, D.M., Wenger, D., 2006. The relationship between maximal repetition performance and muscle fiber type as estimated by noninvasive technique in the quadriceps of untrained women. J. Strength Cond. Res. 20, 699–703.

Foss, M., Keteyian, S., 1998. Fox's Physiological Basis for Exercise and Spor, 6th ed. McGraw Hill, New York.

Ganong, W., 2010. Review of Medical Physiology, 23th ed. The Mc Graw-Hill, California.

Gransee, H.M., Mantilla, C.B., Sieck, G.C., 2012. Respiratory Muscle Plasticity. Compr Physiol 2, 1441–1462.

Hawley, J.A., 2002. Adaptations of skeletal muscle to

prolonged, intense endurance training. Clin. Exp. Pharmacol. Physiol. 29, 218–222.
Hoehn, A.M., Mullenbach, M.J., Fountaine, C.J., 2015. Actual Versus Predicted Cardiovascular Demands in Submaximal Cycle Ergometer Testing. Int. J. Exerc. Sci. 8, 4–10.
Kraps, J., 2001. Muscle Fiber Types and Training. Track Coach 155, 4943–4946.
Magaudda, L., Mauro, D. Di, Trimarchi, F., Anastasi, G., Messina, G.M., 2004. Effects of Physical Exercise on Skeletal Muscle Fiber: Ultrastrucutural and Molecular Aspects. J. Basic Appl Myol 1, 17–21.
Plowman, S., 2007. Exercise Physiology for Health, Fitness, and Performance. Lippincott Williams & Wilkins, USA.
Robergs, R., 2003. Fundamentals of Exercise Physiology. McGraw Hill, New York.
Scott, W., Stevens, J., Binder-macleod, S.A., 2001. Human Skeletal Muscle Fiber Type Classifications 81, 1810–1816.
Skinner, J. 2005, 2005. Exercise Testing and Exercise Prescription for Special Cases: Theoretical Basis and Clinical Application, 3rd ed. Lippincott Williams & Wilkin, USA.
Wang, Y.X., Zhang, C.L., Yu, R.T., Cho, H.K., Nelson, M.C., Bayuga-Ocampo, C.R., Ham, J., Kang, H., Evans, R.M., 2004. Regulation of muscle fiber type and running endurance by PPAR?? PLoS Biol. 2.
Wilson, J.M., Loenneke, J.P., Jo, E., Wilson, G.J., Zourdos, M.C., Kim, J.-S., 2012. The Effects of Endurance, Strength, and Power Training on Muscle Fiber Type Shifting. J. Strength Cond. Res. 26, 1724–1729.