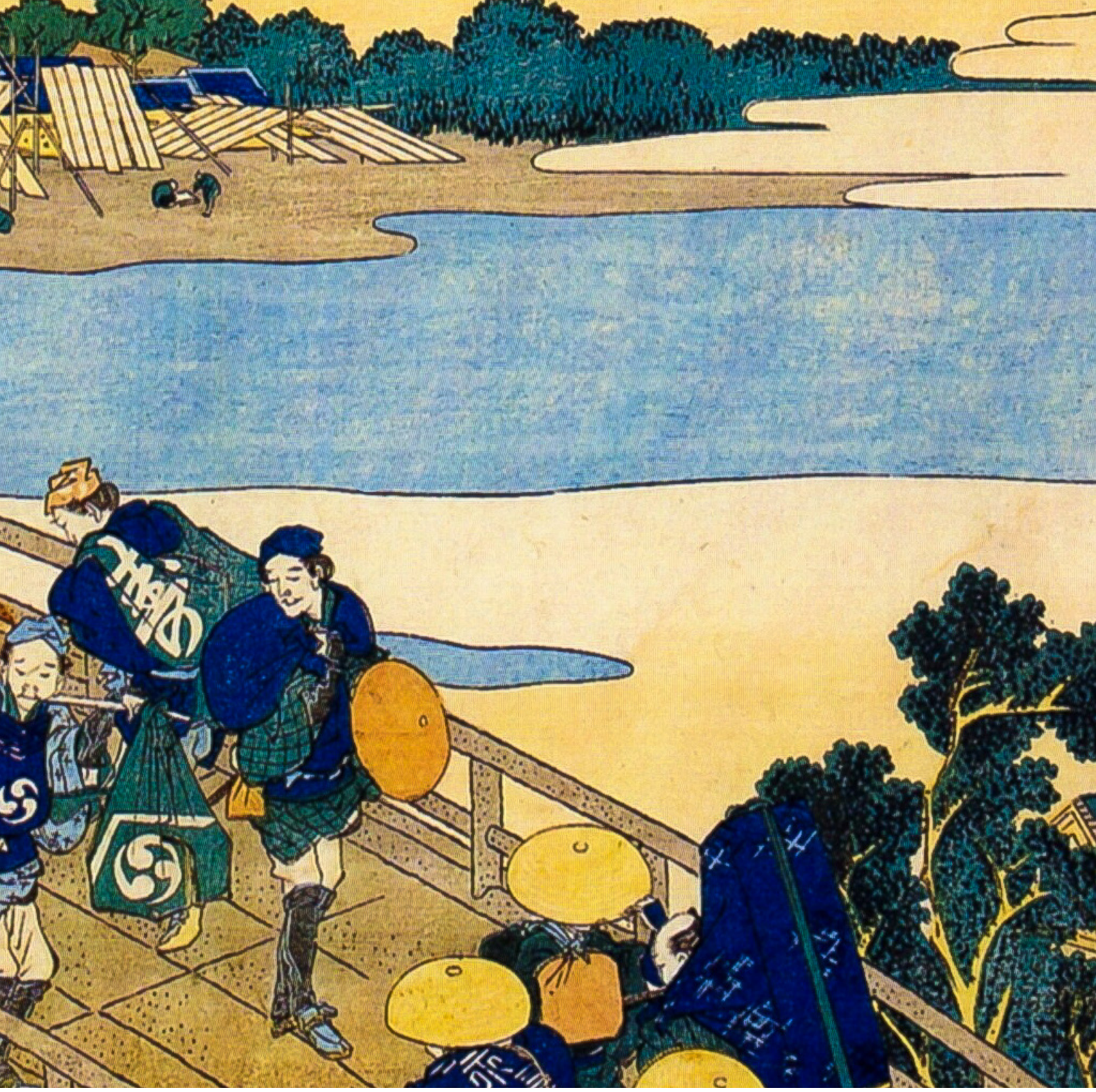

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Republican Freedom against Pluralism

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Abstract
Phillip Pettit has drawn on a republican tradition in order to articulate a conception of the state as primarily oriented towards pursuing freedom, understood as non-domination. In his framework, domination constitutes a harm that the state ought to alleviate. He explicitly treats this ideal as a political one, but in this paper I assert that there does not exist a political domain of life, distinct from the other spheres of our life. I therefore examine the consequences of Pettit's theory throughout other domains of life, contending that non-domination crowds out many other conceptions of the good and thereby lies in tension with pluralism.

Keywords: Political philosophy, political theory, republicanism, non-domination, pluralism, philosophy

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Introduction

Phillip Pettit's theory of freedom as non-domination has been influential in political theory, offering a theoretical framework distinct from liberal and communitarian conceptions. Pettit explicitly treats of this conception as a political ideal, but in this paper, I contend that there is no separate domain of life which corresponds to the political, and that, therefore, Pettit's theory, applied beyond the political, crowds out many other goods we value in life. I then examine a passage on children in order to assert that non-domination, while ostensibly unobjectionable, actually incorporates a problematic reliance on societal consensus.

Freedom as Non-Domination

Pettit presents his theory as connected to a republican tradition which saw freedom as non-domination, rather than non-interference. This view opposes freedom, then, to domination. Pettit characterizes this domination in the following way:

> Domination, as I understand it here, is exemplified by the relationship of master to slave or master to servant. Such a relationship means, at the limit, that the dominating party can interfere on an arbitrary basis with the choices of the dominated: can interfere, in particular, on the basis of an interest or an opinion that need not be shared by the person affected. The dominating party can practice interference, then, at will and with impunity: they do not have to seek anyone's leave and they do not have to incur any scrutiny or penalty. (Pettit, 2002, 22)

Domination, then, is the ability to interfere with another's choices on an arbitrary basis. Importantly, Pettit's conception of domination does not require that such interference actually occurs; all that is needed is the *potential* for such arbitrary interference. He contrasts this view with the view of freedom as non-interference, as defended by liberals like Bentham and Paley, which require that such interference actually occur in order for someone's freedom to be implicated (Pettit, 2002, 49).

Additionally, Pettit's theory relies on a specific conception of arbitrariness. What it means for an act to be arbitrary, on Pettit's view, is that "it is subject just to the *arbitrium*, the decision or judgement, of the agent; the agent was in a position to choose it or not choose it, at their pleasure" (Pettit, 2002, 55). Pettit's conception of domination, then, arises from an agent having the ability to interfere or not *at their pleasure*, rather than with reference to the interests of the dominated.

From this account of freedom, Pettit then posits that freedom as non-domination constitutes a primary good, defined as a good which "a person has instrumental reasons to want, no matter what else they want" (Pettit, 2002, 90). Thus, freedom as non-domination is something which everyone should want. Pettit then shows why such freedom is something which the state should promote.

His argument here rests on two premises. Firstly, he asserts it would be undesirable to let individuals, on their own, pursue freedom as non-domination, for, as Hobbes noted, the state of nature is likely to be a state of war of all against all (Pettit, 2002, 94 – 95). Secondly, the state can act to secure freedom as non-domination. Having thus

established that the state ought to promote freedom as non-domination, Pettit then turns to how it should do so. In particular, he argues that, at least initially, states should treat this freedom as a goal, something to be maximized, rather than as a constraint on state action (Pettit, 2002, 97). This is because achieving more non-domination may well require incidental acts of domination by the state, and these smaller instances of domination (e.g. granting Parliament special prerogatives), can be justified as part of a larger scheme to reduce domination (Pettit, 2002, 102). To test whether such incidental acts of domination can be justified in pursuit of a larger scheme, Pettit invokes the Rawlsian test of reflective equilibrium, noting:

> The relevant test, here as in other aspects of a political theory, is that of reflective equilibrium. The aim of political theory is to find a yardstick for political institutions that it is hard for anyone to question but that proves on examination to prescribe all the measures and patterns that it seems proper, by our considered judgements, to require: an ideal that proves, on reflection and perhaps after revision on both sides, to equilibrate with our judgements about proper political responses, and to help in the extrapolation of those judgements to new cases (Pettit, 2002, 102).

With this test of reflective equilibrium in hand, Pettit then outlines a number of additional aspects to consider in weighing different dominations, before sketching out the institutional picture that freedom as non-domination entails. This test of reflective equilibrium becomes critical later, when we discuss the problems which emerge with Pettit's theory.

No Special Sphere for Politics

Political theory often holds that politics constitutes a special domain of life, distinct and separable from the others. Both liberalism and communitarianism offer an argument for this conclusion, but both face decisive refutations. Liberalism often posits the existence of some special rights that rightly belong to individuals and exist prior to political institutions (Shapiro, 1999, 7). These rights are purported to mark the rightful boundary of state power and a limit on the state's reach. But we lack reliable knowledge of which, if any, conception of individual rights is ultimately correct, and thus, we cannot use a priori methods to demarcate the political and personal. Furthermore, actual practice reveals that "the boundaries to the private sphere are themselves politically constituted and change over time" (Shapiro, 1999, 8). Therefore, any effort to demarcate the political and the personal based on current practices merely naturalizes a particular, politically constructed, view. Both a priori reasoning and reflection on current practice, then, cannot construct a successful demarcation of the personal and the political.

Communitarian thinkers offer an account of communities which are alleged to be apolitical, or "immune from political criticism and action" (Shapiro, 1999, 10). But Shaprio rightly notes that the apolitical nature of such communities arises not from the communities themselves but rather from the political order. Even in the archetypal example of the family as a domain beyond politics, the case of marital rape legislation shows how "the accepted boundaries of politics shift constantly as the result of political struggles" (Shapiro, 1999, 9). There may, then, be domains of life in which politics chooses not to interfere, but there are no domains of life which are beyond the reach of politics.

Thus far, I have given a rejection of other views which separate the political and the personal. Here, I offer a positive argument for this conclusion: because we cannot disentangle the political and the personal in practice, we ought not demarcate them conceptually. The consequences of political activity pervade society, through action and, especially, inaction. The decision of how much to fund public universities, for example, can make a significant difference in how many students go on to higher education. But it's not just through positive action that the government effects changes; inaction, too, produces consequences. The government's decision to not subsidize childcare or improve infrastructure comes with myriad personal ramifications which extend beyond politics and pervade all domains of one's life. Thus, to the extent that some part of one's life is not deeply affected by the government's action, it remains deeply affected by the government's non-action. Consequently, no domain of life, conceptually, may escape the consequences of the political.

This relation, however, goes both ways. In contemporary democratic societies[1], the personal directly implicates the political. When people go to cast their votes, they may employ any set of personally persuasive reasons they wish; the political, then, depends on the personal. And beyond the ballot box, many other domains of one's life implicate the political. In working, an individual contributes to a particular economic order and, thereby, to a compatible political one. Through ostensibly non-political associations (e.g. organized religions), people help determine the interests that political actors will consider. In purchasing and consuming goods, individuals help determine which corporations will have the funds to access political power. The political, then, cannot escape other domains of our lives, all of which tend to produce political consequences.

Thus, no domain of our life can escape the reach of politics, and politics cannot escape the domains of our life. The political, then, cannot be a separate sphere of our lives. But this constitutes a difficulty for theorists like Pettit who develop an institutional vision on the basis of some primary good of politics.

Non-Domination Throughout Our Lives

If we take the thesis of politics pervading our lives seriously, then we have reason to be concerned by theories of politics which posit some greatest good towards which the state should strive. Specifically, we will be concerned by the prospect of this political ideal crowding out the other kinds of goods which we recognize in our own lives. I offer the following example as an illustration.

Imagine that Susan is an employer and has, as a derelict employee, Derek. The state, in designing its regulatory framework, must make the decision of how to structure the regulatory framework. Suppose further that they adopt the value of freedom as non-domination and create a comprehensive regulatory framework to ensure that no employee suffers arbitrary termination. Susan, then, must engage in tedious meetings

[1] An extension to non-democratic societies appears plausible, but I do not make the argument here.

and write-ups before firing Derek, wasting time and resources while Derek continues to perform poorly. Throughout the economy, this results in diminished economic growth and thus diminished wealth for the country's citizens. There lies, here, a clear trade-off between goods: non-domination and economic growth are not perfectly compatible. And while we may be inclined, in this formulation, to prefer freedom, I contend that this problem generalizes. Consider the possibility of religious organizations that incorporate traditions which produce domination. The choice between a religious good and non-domination appears much more fraught, and the state which truly takes non-domination seriously will be obligated to stamp out any dominating practices in these arenas as well. Thus, if we accept that politics pervades our lives and that the state ought to promote non-domination wherever possible, Pettit's theory entails a certain crowding out of other goods. Non-domination may not entail the rejection of these goods, but it will make them secondary and of derivative import, which, at least in some contexts, appears deeply objectionable.

Having laid out a difficulty for viewing Pettit's non-domination as the primary aim for the state, I want to consider two possible defenses of his view. One defense is that non-domination includes certain provisions to prevent the state from itself becoming a dominating agent. These will preclude the possibility that the state will crowd out the other kinds of goods which people can desire. A second defense follows from Pettit's consideration of reflective equilibrium as a limitation to the general rule of maximizing non-domination. I contend both are problematic.

Pettit does consider the possibility that the state will itself become an instrument of domination. Thus, he seeks to minimize the amount of "arbitrary will" in the state's institutional design through a number of institutional features (Pettit 171). His main strategy is to set a constitution that is not easily manipulable by those in power, as well as a contestatory system where decisions can be effectively and democratically challenged (Pettit 172). These achieve non-arbitrary government, since the will of the government is brought in line with the will of those subject to the government's power, namely the people.

Nonetheless, this only brings the state's conception of non-domination in line with that of the people; it doesn't address the problem of multiple goods presented earlier. Even if the state's conception of domination is determined by some democratic majority within a stable constitutional framework, it may still run contrary to other goods, such as economic growth or certain religious practices people value. The state may not be dominating the people as a whole, but that does not obviate the consequences for a particular group of people with different interests and preferences. Thus, even if the state follows these institutional prescriptions in seeking to alleviate domination, it remains true that alleviating domination permits of no other goods, except as secondary and incidental.

In addition to the above procedural prescriptions on state action, Pettit also presents some substantive limits for the state to obey. In particular, Pettit addresses the possibility that such a teleological orientation for the state may entail "intuitively objectionable arrangements," and offers the reflective equilibrium as a way to safeguard against such a possibility (Pettit 102). On Pettit's view, careful reflection will enable us to reject certain policies that, while non-dominating, may appear repulsive for other reasons.

This safeguard moves in the right direction, but it's a direction extending away from non-domination. Once we invoke the reflective equilibrium and our other intuitions, we are no longer solely interested in pursuing non-domination. Thus, we need an account of these other goods which, on occasion, may stand in a higher degree of importance than non-domination. Accordingly, while this objection may preserve Pettit's non-domination as an important good in politics, it ultimately relegates non-domination to being only another, and not determinative, political good.

The problem, then, remains. A non-dominating state, through democratic and constitutional mechanisms, conceives of and enforces a particular conception of non-domination which may lie in conflict with many other goods in the lives of citizens. Because political activity cannot be sectioned off from other domains of life, the state must thereby reach out and root out all conceptions of the good which conflict with non-domination. In addition, it must seek to make even practices which already promote non-domination into ones which optimally promote non-domination. Use of reflective equilibrium may help mitigate these objections, but to the extent that it does so, we move away from Pettit's non-domination.

These conceptual problems for non-domination appear formidable. Nonetheless, the policy prescriptions that Pettit reaches from his framework of non-domination look surprisingly close to those produced by other political theories. The state will promote women's rights and redistribute tax revenues to benefit the worst off; it will protect its citizens but refuse to engage in imperialist enterprises. Thus, one might wonder if the concerns I've raised here translate to the level of actual policy. I turn, then, to a particular application to explore why we might find the justificatory structure of non-domination concerning.

Children and Non-Domination

Children, as Pettit recognizes, occupy a special place when thinking about non-domination because they lack the competencies of adults. Specifically, they require "education and development" in order to become competent individuals (Pettit, 2002, 119). Thus, Pettit states:

> Children cannot be given the same opportunities as adults if they are to be enabled, when they become adults, to enjoy the sort of non-domination which a republic would confer: they must be subjected to the disciplines inherent, as any parent knows, in fostering education and development. (Pettit, 2002, 119).

This isn't, however, to state that children receive no protections in Pettit's theory, Rather, the state must hold parents and teachers to constraints in order to ensure:

> First, they will seek to advance the relevant interests of the children; and second, that they will seek to promote those interests by non-idiosyncratic lights. Parents and teachers would be allowed to exercise considerable interference in the lives of children, in other words, but the interference would be designed to track the children's interests according to standard ideas, and it would not constitute a form of domination. (Pettit, 2002, 120).

This excerpt puts, in a particularly sharp way, the problem which I have been discussing. Few disagree with the idea that parents should seek to promote the interests of their children. The crux of the debate occurs in how, exactly, parents ought to do so. Non-domination resolves these difficulties with reference to societal agreement, given under certain constraints. Thus, parents can legitimately be held to the extant social standard for appropriate parenting. This conception, however, problematically rules out a legitimate diversity in conceptions of the good, whether it is of good parenting or good in other domains of life, except to the extent that the consensus permits it. When we look at specific instances of legitimate conflict over the interests and goods people choose, the resolution promoted by non-domination appears controversial. Non-domination in practice, then, seems not to be the kind of primary good it is in theory.

Conclusion

Freedom as non-domination is a primary good almost by definition. No one wants to be dominated, if being dominated means being subject to arbitrary interference and arbitrary interference is interference which doesn't track one's own interests. Asserting that such freedom is a primary good, then, is equivalent to asserting that people want what is in their own interest. The problem, then, lies not in the ideal; the ideal is certainly a primary good.

The problem arises once we try to put this ideal into practice. The state must, inevitably, choose a particular conception of non-domination, which requires choosing among different people's interests and thus their conceptions of the good. In Pettit's theory, the state does so in a particular way, with democracy and certain constitutional constraints. We might think such a system is a good idea, but it's clear that we are no longer dealing with the same primary good from before. We are here enforcing a particular, contestable notion of non-domination which many may disagree with, and we are employing the pervasive force of state power to do it. Non-domination, then, has much potential for domination.

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Development of Cheap Flow Meter

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Abstract
In this study, we developed a cheap flow meter. There are two purposes in this study. One is to reduce a cost of flow rate measurement in rivers. Another purpose is to measure a flow rate at many points at the same time. The principle of the flow meter is Bernoulli's theorem. Main material of the flow meter is PVC pipe. The control unit of the flow meter is Arduino. Moreover, we used ultrasonic sensors to measure a differential of a water level. The cost of the developed flow meter is only little over 5000 yen. After we developed flowmeter, we did an experiment. As a result of the experiment, the flow meter showed a potential to measure a flow rate.

Keywords: Environment sensing, flow meter, Bernoulli's theorem

Introduction

There are many rivers in Japan. The Regular investigation is necessary to manage them. There are various items to survey such as flow rate, water quality, pH etc. Currently, a large number of personnel and expenses are required to investigate each item. Also, it is preferable to measure flow rate at many points, Sera (1991, p.292), Nezu, Nakagawa and Seya (1991, p350). However, in the previous study, they used one flow meter to measure at many points. It takes a lot of labor. So we consider that measure flow rates many points at the same time. There are various methods for measuring the flow rate. Currently mainly used in Japan is a system using a float and a system using a machine called ADCP. A method called float type has been used for a long time in Japanese rivers. It is a method of dropping a float with a mark from a bridge and calculating the flow velocity from the time elapsed while float flowed a certain distance. The method of float type needs at least 5 people (leader, subleader, the person dropping, 2 people signaling the passage of a float), Hashiba, Kai, Tsuda and Tsuchida (2014, p.39). Therefore, this method needs personnel expenses and increases human error. In recent years, the method of using ADCP have been studied and used to practical use. ADCP is a machine that generates ultrasonic waves in water and calculates the flow velocity from the phase shift of the reflected ultrasonic waves. By using ADCP, it became possible to measure the flow velocity in the depth direction at once. In addition, by manipulating a small unmanned boat with ADCP with a rope from above the bridge, it became possible to measure the flow velocity in the horizontal direction in a short time. However, because of ADCP's price, organizations that can be introduced are limited. Moreover, in order to measure the flow velocities of multiple points by these methods, it is necessary to measure multiple times while shifting the measurement point. The float type is difficult to follow the flow of multiple floats. Also, since the flow of the river is not straight, it is impossible to measure the flow velocity at pinpoint by dropping the float. On the other hand, multiple ADCP can't be used at the same time. The reason is a possibility of misdetection, because of another ADCP's ultrasonic waves. As a result, it was impossible to survey a flow rate at multiple points at the same time by the method of float or ADCP. Also, there are other methods for measuring. That is a method of using propeller and a method of an electromagnetic flowmeter. Usually, these methods are not used in the river. Moreover, the price of these flow meter is more than 300,000 yen. Therefore, prepare many flow meter spends much money, and it is difficult to measure the flow rate at many places at same time. So we decided to develop a cheap flow meter which can measure flow rate many points at the same time.

Principle of developed flow meter

We developed cheap flow meter using Bernoulli's theorem. Bernoulli's theorem is that total amount of followings is constant: pressure, flow rate, and potential energy. Bernoulli's theorem is used for pitot tube. Pitot tube is mainly used for measuring the speed of the airplane. The general shape of pitot tube is shown in fig. 1. Pitot tube is made of transparent material such as glass. There are 3 holes at the pitot tube under the water. One is a total pressure hole, which is in the flow. Other two holes are static pressure hole, which does not in the flow. The purpose of pitot tube is to measure the dynamic pressure for measure the flow rate. However, there are not only dynamic pressure but also water pressure in the water. Therefore, the pitot tube is calculating

differential pressure from total pressure and static pressure. There are two methods for measure differential pressure. One is to use a differential pressure gauge and the other is to read the difference in water level. The method of use a differential pressure can't achieve the purpose of this study: develop a cheap flow meter. The reason is that differential pressure gauge isn't cheap. On the other hand, a method of reading the difference in water level is not suitable for measuring many points at the same time. The reason is that this method is conventionally read by a human. As a result, it does not solve a problem of the method which uses float. So we use an ultrasonic sensor to read a difference of water level. By using the ultrasonic sensor, the acquired value can be sent directly to the database etc. As a result, it is possible to prevent human error and reduce personnel expenses.

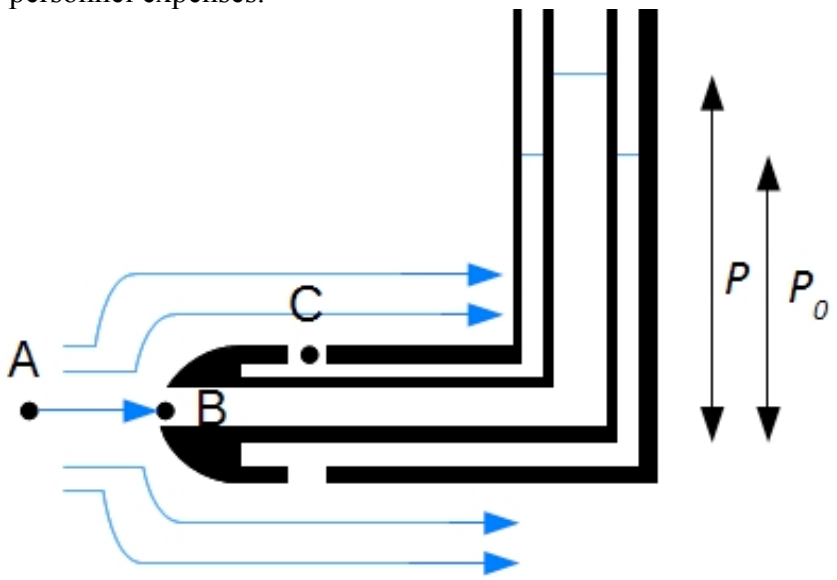

Fig. 1 General shape of pitot tube

Developed flow meter

Fig. 2 is a picture of flow meter which we developed. It can divide into two parts: measuring part and calculation part. Table 1 shows parts and price of the flow meter. This flow meter developed at little over 5000 yen. It shows that this flow meter is much cheaper than any other flow meter.

Fig. 2 Developed flow meter

Table 1 Parts and price of flow meter

parts	Price
PVC pipe	￥500
Ultrasonic sensor ×2	￥800
Arduino	￥3240
Bord,wiring,etc.	￥500
Total	￥5040

Measuring part

There are two tubes at flow meter: total pressure tube and static pressure tube. These tubes use 5 cm diameter PVC pipes. These tubes are same long and both tubes have a cap set at the tip of the underwater. Total pressure tube has a hole on the side and static pressure tube has a hole on the bottom. These holes correspond to total pressure hole and static pressure hole in the pitot tube. Also, there are ultrasonic sensors at the top of both tubes. These sensors measure the distance between a top of tube and water level. The difference of water level between total pressure tube and static pressure tube can calculate from 2 ultrasonic sensors.

Calculation part

Fig. 3 shows the connection diagram of the machine used in the calculation part. There are some machines for calculating difference of water level: PC, Arduino, and two ultrasonic sensors. Arduino gets the value from two ultrasonic sensors and sends calculation results to PC with serial communication. The calculation result is the average value of the 30-second water level difference.

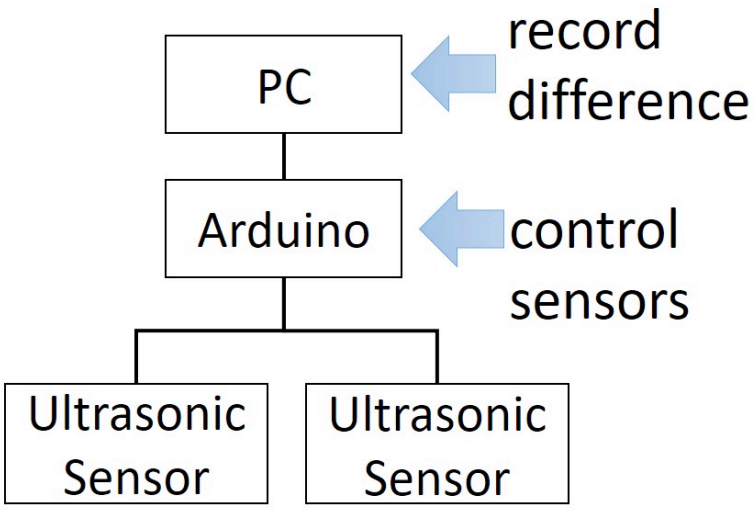

Fig. 3 Connection diagram of the machine used in calculation part

Principle of measurement

Fig. 4 shows the principle of measurement in a developed flow meter. The flow meter has two holes. To measure the flow rate from the water level difference, use the following equations from Bernoulli's theorem. Eq. (1) shows that total of the pressure of point A and the flow rate is equal to the pressure of point B. Eq. (2) is a modified version of Eq. (1). It is an equation for flow velocity. From these equations, the flow rate can be measured by the difference in water level between the total pressure pipe and the static pressure pipe.

$$p_A + \frac{1}{2}\rho v^2 = p_B \quad (1)$$

$$v = \sqrt{2 \cdot (p_B - p_A)} \quad (2)$$

$$= \sqrt{2 \cdot \Delta h} \quad (3)$$

v	: Flow rate$[m/s]$
Δh	: Difference in water level [m]
p_A, p_B, p_C	: Pressure of point A,B,C
ρ	: Density of the fluid ($\fallingdotseq 1$)

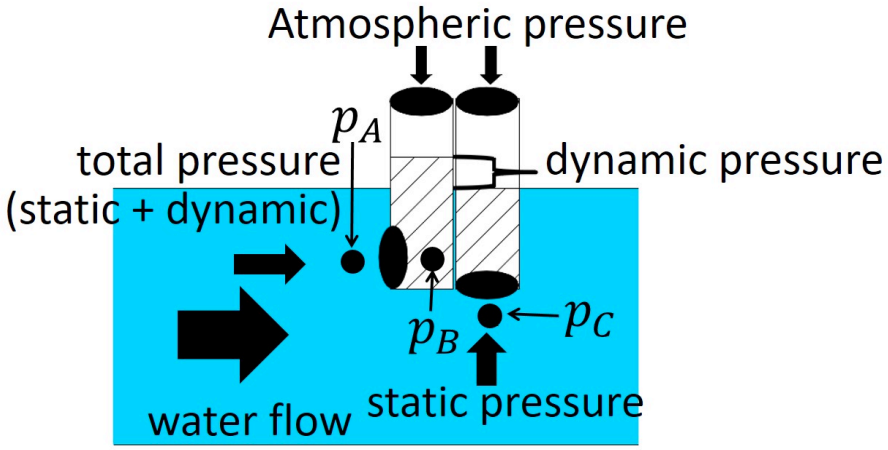

Fig. 4 The principle of measurement in a developed flow meter.

Experiment

We experimented to confirm the measurability of flow meter which we developed. Our experiment has held at the experimental water tank at Tokai University, Japan. The experimental water tank is 0.5m width and 8m long. It can create water flow artificially. Experiment situation is shown in fig. 5. In the experiment, we hanged the flow meter over the water tank.

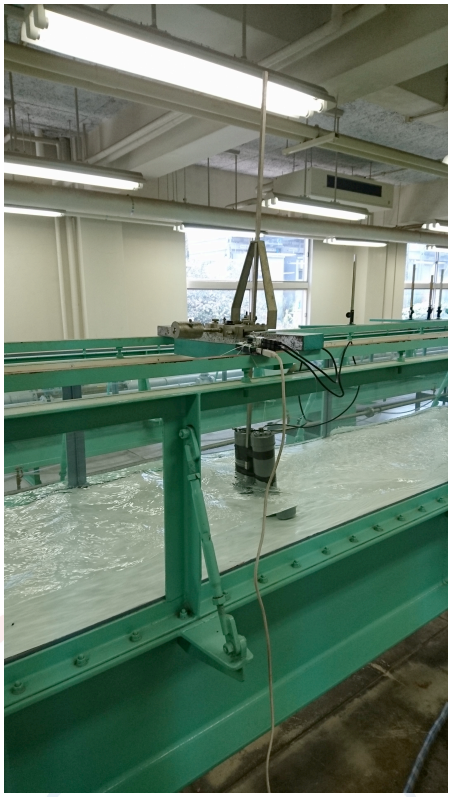

Fig. 5 Experiment situation

Result

Fig. 6 is a graph of the experimental result. Measured range of this experiment is 0.51m/s to 0.79m/s. The reason why under 0.51m/s and over 0.79m/s couldn't measure is that depending on constraints of facilities. Too slow flow rate doesn't make sufficient water level. The reason for low water level is a correlation of outflow and flow rate. Also, too fast flow rate make drainage cannot catch up. The theoretical value and the measured value maintain almost the same slope between 0.5 m/s and 0.6 m/s in fig. 6. On the other hand, the measured value showed a steep increase from the theoretical value after 0.6 m/s. For that reason, we can judge whether the flow rate is getting faster or slower from the flow meter.

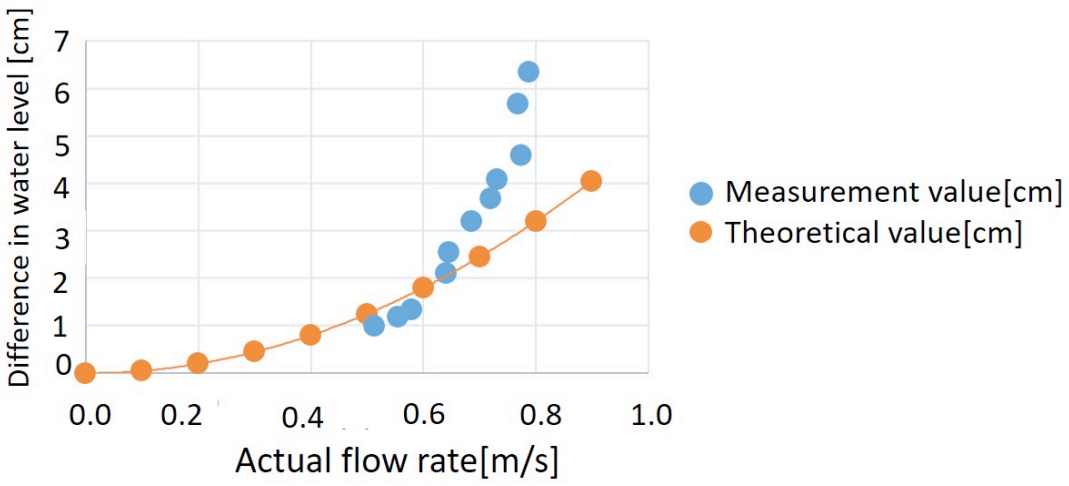

Fig. 6 Experimental result.

Discussion

The goal of this research was to develop a cheap flow meter that could be used simultaneously. Fig. 7 is the picture of flow meter from the side. This picture shows two reasons why the result of measurement is not expected value. The first reason is that water level is changing at the front and behind flow meter. This is caused by the fact that the flow meter disturbs the flow. Fig. 8 is the top view of the experimental facility. The flow meter is made of 2pipes which are 5 cm diameter. Wide of the experimental water tank is 50cm. In other words, the flow meter is blocking one-fifth of the waterway at the experimental tank. As a result, it is expected that complicated water currents are generated behind the water flow meter. Thereby, it seems that the water level is changing at the front and behind flow meter. The second reason is that pipe is leaning. The reason of leaning is strong water resistance. Water resistance increases as the flow rate increases. Therefore, as the flow rate increases, the lean of pipe increases. Fig. 9 shows the change in the distance of the ultrasonic sensor due to the lean of the pipe. The measurement value of the ultrasonic sensor is measured by the distance from Tx: a transmitter to Rx: a receiver. When the pipe is set vertical to the water surface, the distance from Tx to Rx is 20cm. However, if the pipe tilts 10 degrees, the distance from Tx to Rx is 20.9cm. As a result of the lean of the pipe, distance from the ultrasonic sensor to the water surface is not accurate. For these two reasons, it is considered that the measured values after 0.6 m/s showed a rapid rise. In order to reduce the fluctuation of the water level by the flow meter, it is considered that miniaturize the flow meter itself. Especially, it is considered that reduce the diameter of the pipes which diameter are 5 cm is important.

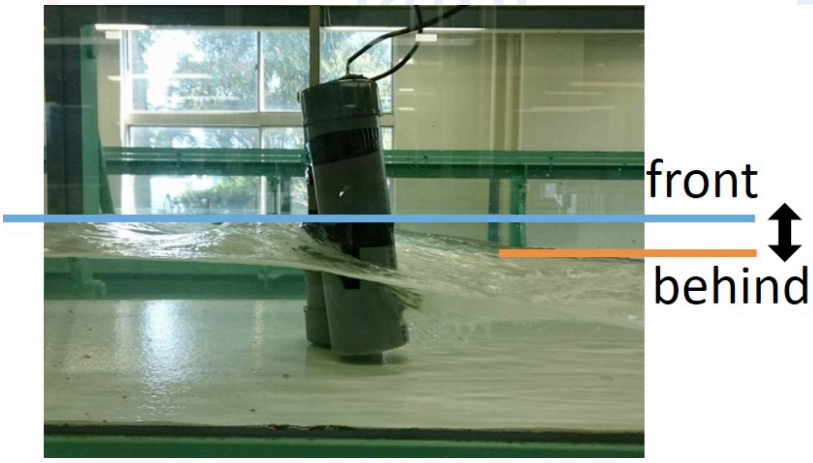

Fig. 7 Picture of flow meter from the side

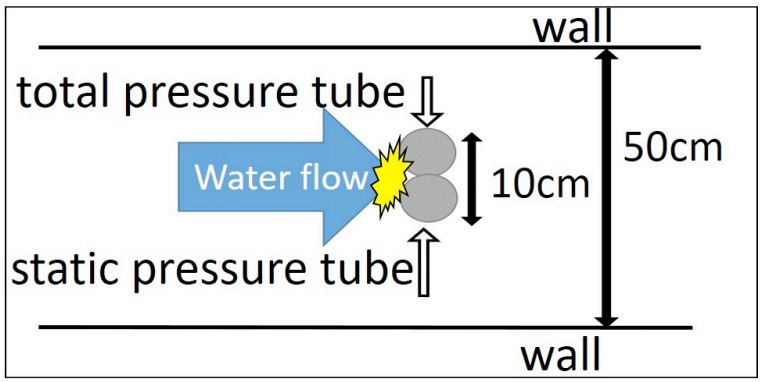

Fig. 8 Top view of the experimental facility

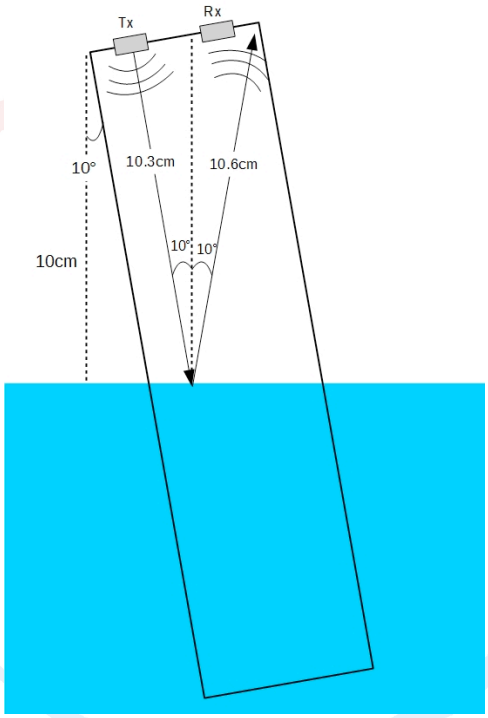

Fig. 9 Change in the distance of the ultrasonic sensor due to the lean of the pipe

Conclusion

We developed cheap flow meter as compared with conventional ones. We also showed the possibility of measuring flow meters developed. However, there is still room for cheapness. The reason is that most of the cost is Arduino. It is considered that change Arduino to microcontroller chip, and flow meter get cheaper. For the future plan, we miniaturize the flow meter and improve the accuracy of the flow meter.

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The Design of a Small Footprint Versa Writer Control Chip

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Official Conference Proceedings

Abstract
High-level synthesis tools have been drawing attention because we can reduce design costs. However, it seems that we cannot consider circuit timing when we design circuits. In this paper, we present the design of a versa writer control chip with NSL (Next Synthesis Language). The versa writer consists of our control chip, 24 RGB LEDs, a clock generator, battery and an I2C serial EEPROM. We place the LEDs in-line to make the vertical line of the picture and characters. We utilize the human afterimage to make the images on the air. The inline LEDs will display the vertical line one by one for a short period. When users shake the versa writer, the afterimage of the inline LEDs makes the pictures. We store the data of the pictures in ROM in advance. We designed the control circuits of LED and ROM with NSL. We checked the operation of the versa writer on FPGA. We succeeded in displaying of the pictures. Our result indicates that we can develop a critical timing system with the high-level synthesis language. Then, we designed a layout of the circuit with an open source EDA tool Alliance. We fabricated a prototype chip from the layout.

Keywords: versa writer, CMOS ASIC, high level HDL design

1. Introduction

We can program logic circuits on the device FPGA (Field Programmable Gate Array). Hardware processing with FPGA is lower power consumption and faster processing speed than software processing with CPU. Thus FPGA has been used in many fields. As an example, Microsoft has used servers equipped with FPGA, and it has speeded up Bing search engine. In financial field, HFT (High-Frequency Trading) has worked on FPGA. Image processing and communication processing also have been speeded up like these. In the future, application of these to artificial intelligence is expected.

We generally used some RTL (Register Transfer Level) descriptions such as Verilog HDL and VHDL when we design circuits. However, there is a problem that RTL descriptions take a long time when we program complex processing. Therefore, high-level synthesis tools have been drawing attention because we can reduce design costs. We design circuits with high-level synthesis languages. The high-level synthesis tools convert the circuits into RTL descriptions. Many researchers develop a system with the tools. By way of example, as tools based on C, there have been CoDeveloper (Ohno, Nakahara, Izumi, & Lin, 2014; Kawai & Izumi, 2014), Bach system (Nagai, Kambe, & Fujita, 2014), Cyber Work Bench (Sugimoto, Miyajima, Kuhara, Mituishi, & Amano, 2014), Vivado (Georgopoulos et al., 2016; O'Loughlin, Coffey, Callaly, Lyons, & Morgar, 2014), and so on. As tools based on Java, there have been JavaRock (Miyoshi & Funada, 2011), MaxCompiler (Fukui & Fujita, 2011), and so on. In addition, as tools based on Python, there have been PolyPhony (Sinby Corporation, n.d.), and so on.

Circuit descriptions used the high-level synthesis languages are easy because the circuit descriptions have a higher level of abstraction than the RTL descriptions. However, in the case of using the languages, it seems that we cannot have considered circuit timing when we design circuits. Thus we developed a system used a high-level synthesis language NSL (Next Synthesis Language). Here we present that we can develop a critical timing system with the high-level synthesis language. To achieve this goal, we design a versa writer control circuit with NSL. As another problem, it seems that we cannot have designed chip layouts with these languages. Therefore, we designed a layout with an open source EDA (Electronic Design Automation) tool Alliance. Alliance generates chip layouts consistently after converting NSL into RTL descriptions. Here we present that the tool can generate chip layouts from the high-level synthesis language. To demonstrate this point, we fabricate a versa writer control prototype chip with a generated layout.

2. Methods

2.1. Specification of NSL

NSL is the hardware description language (HDL) developed by Overtone Corporation. Unlike existing HDL, behavior level descriptions are possible. It is relatively easy to learn NSL because the syntax of NSL is like C. It is possible to convert to Verilog, VHDL, and SystemC with the tool NSL Core. Thus we can perform logic synthesis and simulation with NSL.

2.2. Specification of the prototype chip

Fig. 1 shows the specification of our prototype chip. In the case of CMOS process of our chip, the minimum gate length is 2μm as well as the chip has a layer of polysilicon gates and two layers of aluminum wiring. The chip size is 3.2mm square, but we cannot design any circuits in the area with Input/Output pins and so on. Thus we can design layouts in only 2.5mm square area. The layout area cannot contain large circuits because the chip size is small and a lot of fabricating is by hand.

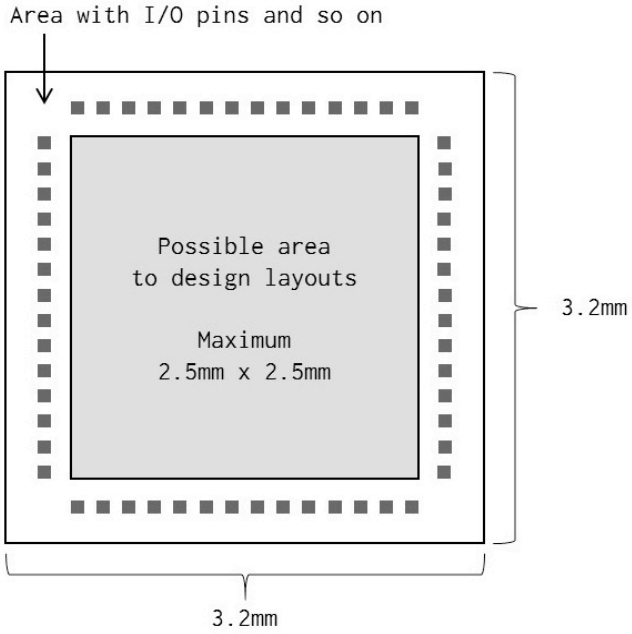

Figure 1 The specification of our prototype chip

2.3. Specification of a versa writer

Fig. 2 shows the specification of a versa writer. The versa writer is a device shaped like a rod. Some LEDs are lined up on the versa writer. We used 24 RGB LEDs. When we shake the versa writer in the dark, an afterimage makes pictures and characters. The afterimage is like a pixel art. We stored data of the pictures and characters in an I2C serial EEPROM in advance.

We explain an operating principle of the versa writer. First, once a versa writer controller transfers the first line of data, the LEDs turned on as the first data. Then, the controller transfers the second line of data once we shake the versa writer only a little. After transferring the second data, an afterimage leaves the first data, and the LEDs turned on as the second data. The afterimage makes pictures and characters by repeating this processing for a short period.

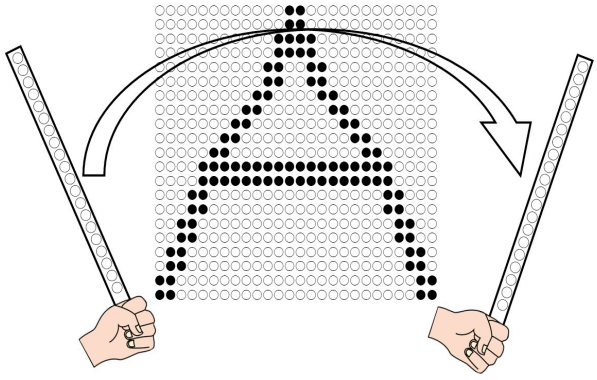

Figure 2 The specification of a versa writer

2.4. Structure of versa writer

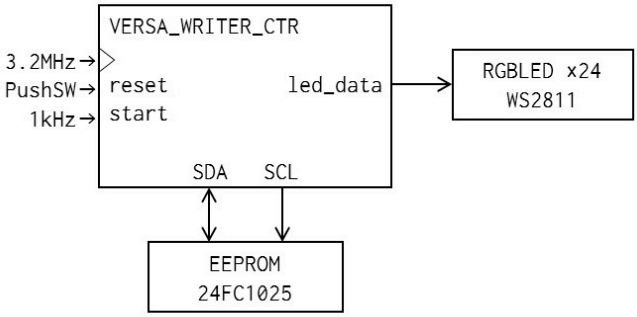

Figure 3 The structure of the versa writer

Fig. 3 shows the structure of the versa writer. The versa writer control circuit transfers data to RGB LEDs. We store the data in an EEPROM. The circuit changes a lighting pattern of LEDs whenever 1kHz start signal rises. We use RGB LEDs WS2811 and an EEPROM 24FC1025. Both LED and ROM operate at 400kHz. We have to reduce the circuit scale because we fabricate a versa writer control prototype chip. Thus we have to reduce the number of registers in the circuit. We do not have to use any buffers because LEDs and ROM operate at the same timing.

2.5. RGBLED control circuit

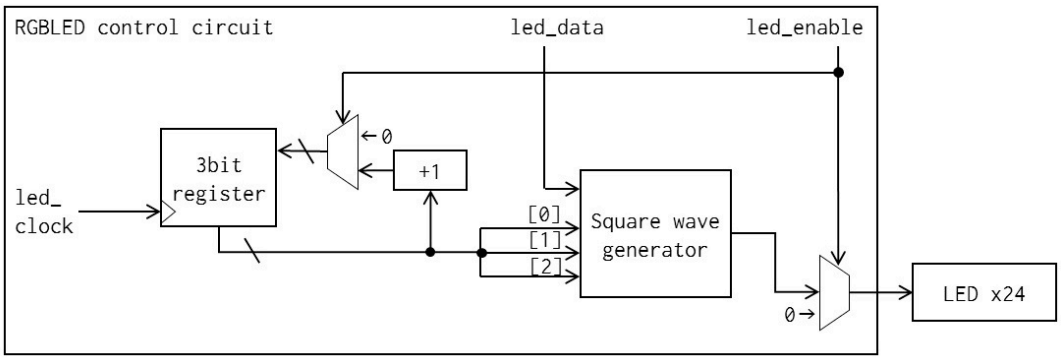

Figure 4 LED control circuit

A LED control circuit is described in Fig. 4. Once a ROM circuit transfers data as led_data, the circuit outputs a square wave. The wave corresponds to the data. In the

case of the LED, a wave of 50% duty cycle is 1, and one of 12.5% duty cycle is 0. We generate the wave with a counter. The counter synchronize with a 3.2MHz clock because transferring a wave has to synchronize with a 400kHz clock. Data outputted to the LED is 24bit. The data contains 8bits of red data, 8bits of green data and 8bits of blue data. A LED is turned on or off once the circuit transfers 24bits of data to the LED. As an example, the LED is turned on in red once the circuit transfers 0xFF0000. In addition, we can connect more than one LED in the way of cascade connection. The circuit can output each data to all LEDs because the LEDs have a microcomputer. The circuit has to output a reset signal for over 50μs after the circuit outputs as many data of 24bits as the number of the LEDs connected. The circuit decides whether it outputs the wave or the reset signal. The circuit transfers the wave when led_enable is 1, and it transfers the reset signal when led_enable is 0.

2.6. EEPROM control circuit

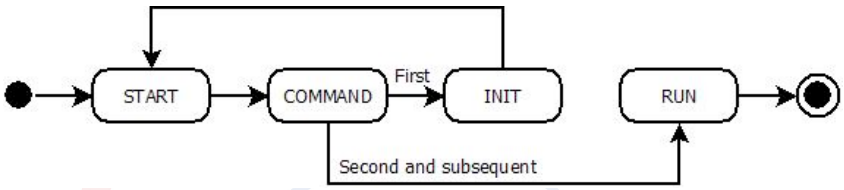

Figure 5 A state transition diagram of a ROM control circuit

Fig. 5 shows a state transition diagram of a ROM control circuit. There are SDA (Serial DAta) signal and SCL (Serial CLock) in the ROM. We use SDA signal for sending commands, and we use it for sending and receiving data. The ROM sends and receives a bit of a command or a data at a time since the ROM uses serial communication. The circuit outputs 400kHz clock to SCL signal.

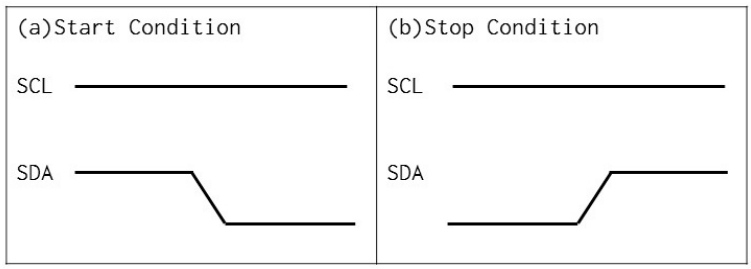

Figure 6 A wave of start/stop condition

The circuit sends a start data to ROM in the START state. The way of sending the start data is that SDA signal is changed to LOW from HIGH while SCL signal is HIGH as indicated in Fig. 6(a). The circuit sends a stop data to ROM in finishing processing. The way of sending the stop data is that SDA signal is changed to HIGH from LOW while SCL signal is HIGH as indicated in Fig. 6(b).

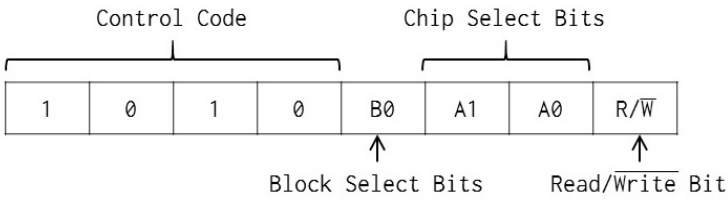

Figure 7 The format of the control byte

During the COMMAND state, the circuit sends information about doing now. The circuit uses a control byte for sending information. Fig. 7 shows the format of the control byte. First, the circuit sends 4bits of the control code '1010', then selects a block of ROM. We select 0 when we want to use the former half of blocks, and we select 1 when we want to use the latter one. If we connect more than one ROM, we specify next 2bits of an identifier to select a ROM. Finally, we select whether reading or writing. In first COMMAND state, we select writing to specify a reading address. In second and subsequent, we select reading to read data. The circuit receives ACK (Acknowledgement) signal from ROM after sending the control byte.

The state of the circuit transitions to the INIT state from first COMMAND state. During the INIT state, we specify an initial address of reading data. The circuit sends 8bits of a lower address after sending 8bits of an upper address. The circuit receives ACK signal after each sending the address.

The state of the circuit transitions to the RUN state from second and subsequent COMMAND state. During the RUN state, the circuit receives 8bits of data in order from the initial address. The circuit sends ACK signal after receiving 8bits of the data. The circuit finishes the processing after receiving as many data as the number of LEDs connected. After the lapse of 1ms, the circuit begins the processing with the START state and receives the following data. By repeating the state transition, the circuit can change data for sending to LEDs at the same time as we shake the versa writer only a little.

2.7. Flow of designing layouts

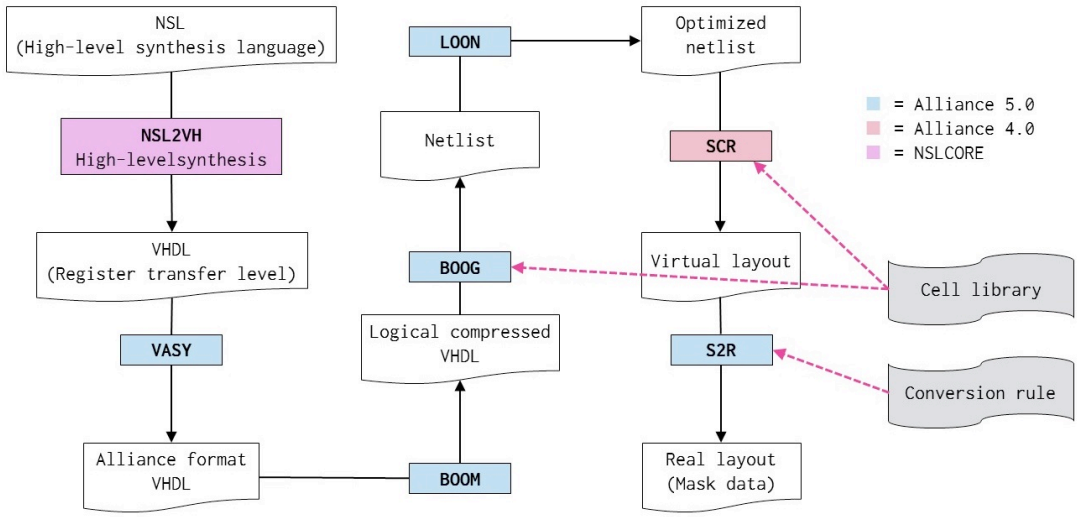

Figure 8 The flow of designing layouts

Fig. 8 shows the flow of designing layouts. We use the open source EDA tool Alliance for designing layouts. A high-level synthesis tool NSL2VH convert NSL descriptions circuit into VHDL descriptions because Alliance uses VHDL. VASY convert into Alliance format VHDL descriptions. BOOM performs logical compression, and BOOG generates a netlist. The netlist corresponds to a cell library. The cell library contains cell patterns of various circuits, for example, an inverter, an AND circuit, an OR circuit, a flip-flop circuit and so on. The netlist is descriptions how to connect these cell patterns. Then LOON optimizes the netlist. SCL generates a virtual layout, and S2R generate a real layout according to a conversion rule.

3. Results

First, we designed a layout of our circuit. We fabricated a prototype chip of only the LED control circuit because the layout area could not contain the whole of the versa writer control circuit. Fig. 9 shows the chip layout. We implemented the ROM control circuit on MAXV, and we connected the circuit to the LED control chip.

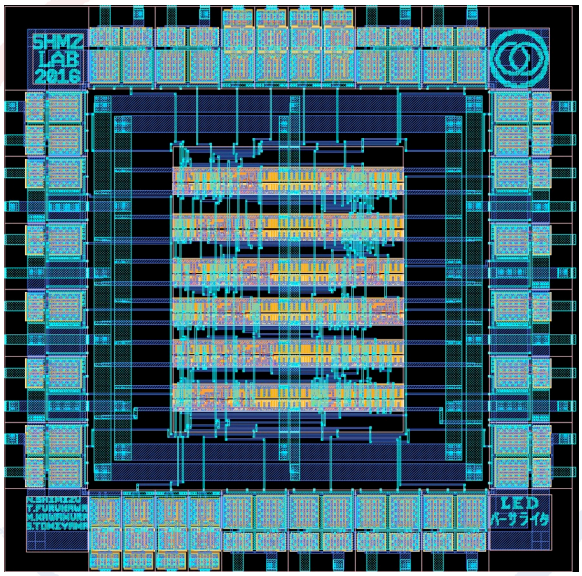

Figure 9 The chip layout of the LED control circuit

We implemented the LED control circuit on DE0-CV, and we tested the circuit before fabricating the prototype chip. We performed logic synthesis with Quartus II after converting NSL into Verilog. Fig. 10 shows the test result. It can be seen that the circuit output a square wave of 12.5% duty cycle when SDA signal is 0. In addition, it can be seen that the circuit output one of 50% duty cycle when SDA signal is 1. We connected the circuit to MAXV, and we checked the operation of the versa writer. Fig. 11 shows the operation result. An afterimage makes characters in the dark. Then we fabricated the prototype chip, but we are checking the operation of the chip.

Accordingly, it is possible to say that we can develop critical timing systems with NSL. We could also design the layout consistently. However, it remains an open question whether the method is effective or not because we cannot have tested the prototype chip yet.

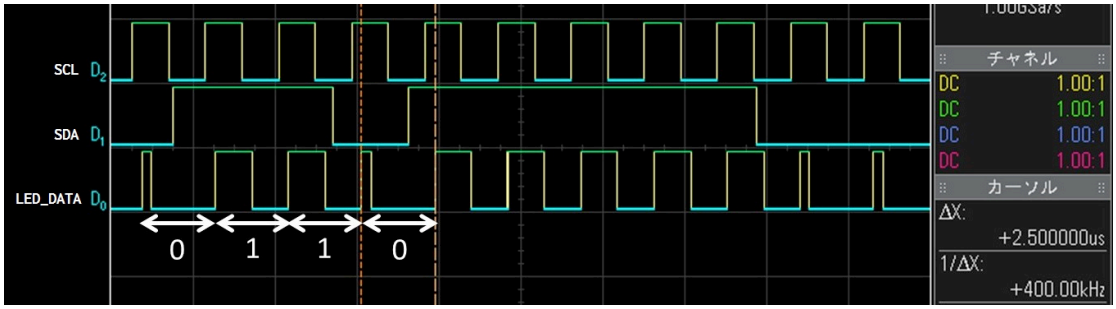

Figure 10 The test result of the versa writer control circuit

Figure 11 The operation result of the versa writer

4. Discussion and Conclusion

Our goal in this paper has been to present that we can develop a critical timing system with the high-level synthesis language. In addition, another goal has been to present that we can also generate chip layouts from the high-level synthesis language. By designing the versa writer control circuit, we presented that we can develop the critical timing system with the language NSL. The considering timing of circuits has received little attention in previous studies. However, as a result of our development, it has come to light that we can develop not only arithmetic processing but also such a system with the high-level synthesis language. About the result of designing the layout, we cannot have tested the prototype chip yet. In the future, we need to test the chip because we need to establish the usefulness of the language NSL and the tool Alliance. Then, we will aim to fabricate the one-chip from the whole of the versa writer control circuit. It remains a challenge for future research to design layouts consistently from modeling languages.

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The Differences of Sugar-sweetened Consumption Averages according to Some Factors among Students of SMAN 48 East Jakarta 2016

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The Asian Undergraduate Research Symposium 2016
Official Conference Proceedings

Abstract
Sugar-sweetened beverages are certain types of calorie drinks which are ready to drink when it purchased. This research aims to get information about the differences of sugar-sweetened beverages consumption averages among students of SMAN 48 East Jakarta according to sex, mass media exposure, accessibility, availability, family influence, peer influence, nutritional knowledge, attitude, physical activity, the habit of bringing mineral water, and pocket money. This quantitative study (cross sectional) is conducted to 168 samples (quota sampling method). Self-administered Questionnaire and various sized bottles are used as the instruments of this research. The result showed that the average of sugar-sweetened beverages consumption in general was 245,7 mL/day. The averages of sugar-sweetened beverages consumption based on its categories were tea/coffee (152,7 mL/day), fruit-flavored drinks (77,1 mL/day), flavored drinks (without fruit juice) (65,7 mL/day), sports drinks (56,9 mL/day), caloric carbonated drinks (42,2 mL/day), and energy drinks (10,0 mL/day). Bivariate analysis (t-independent test) showed that there was a significant difference on the average of sugar-sweetened beverages consumption according to sex, mass media exposure, availability, peer influence, and attitude. Support from various authorities related to sugar-sweetened beverages sales policy and free mineral water supply in public places, especially school, are needed to reduce sugar-sweetened beverages consumption.

Keywords: sugar-sweetened beverages, sex, mass media exposure, availability, peer influence, attitude

Introduction

Sugar-sweetened beverages (SSBs) are certain drinks which contain about >50 calories per 1 serving (1 serving = 8 oz = 236,59 mL) (Singh, *et al.*, 2015a; Singh, *et al.*, 2015b). High consumption of sugar-sweetened beverages has been linked with overweight and obesity among children and adults (Ludwig, *et al.*, 2001; Schulze MB, *et al.*, 2004; Malik, *et al.*, 2006; Vartanian, *et al.*, 2007; Malik, *et al.*, 2010; Ezendama, *et al.*, 2010; Hafekost, *et al.* 2011; Ebbeling, *et al.*, 2012; Malik, *et al.*, 2013; Gase, *et al.,* 2014; Yon & Johnson, 2014). Consumption of caloric carbonated drinks has correlation with higher energy intake, lower milk consumption, and other nutrients (Vartanian, *et al.*, 2007). Although overweight and obesity occur in various subpopulation, most of them have been found among children and adolescents (Reedy & Krebs-Smith, 2010).

Global average intake of SSBs were 0.58 servings/day (137.2 mL/day) (Singh, *et al.*, 2015a; Singh, *et al.*, 2015b). In East and Southeast Asia, intake of SSBs were 0.6 servings/day (142.0 mL/day) (Singh, *et al.*, 2015a; Singh, *et al.*, 2015b). In Indonesia, the proportion of people aged ≥10 years old who consume sweet foods/drinks ≥1 time/day was 53.1% (Depkes RI, 2013). In Jakarta, the capital of Indonesia, the proportion of people aged ≥10 years old who consume sweet foods/drinks ≥1 time/day was 61.4%, which ranked eighth place from 33 provinces in Indonesia (Depkes RI, 2013). In East Jakarta, 40.3% of respondents from high school students was categorized as high level consumption of carbonated drinks (Fauzia, 2012). Various SSBs that are sold everywhere in Indonesia make everyone can find SSBs easily. Moreover, the negative effects of overconsume SSBs make this reseach become important.

This research aims to get information about the differences of SSBs consumption averages among students of SMAN 48 East Jakarta acording to sex, mass media exposure, accessibility, availability, family influence, peer influence, nutritional knowledge, attitude, physical activity, the habit of bringing drinkng water, and pocket money.

Literature Review

Sugar-sweetened beverages (SSBs) is defined as drinks which contain about >50 calories per 1 serving (1 serving = 8 oz = 236,59 mL), including caloric carbonated drinks, fruit-flavored drinks, energy/sport drinks, tea, and homemade drinks (Singh, *et al.*, 2015a; Singh, *et al.*, 2015b). According to Harris, *et al.* (2014), any products that contain 1 gram added sugar per 8 oz serving is already categorized as SSBs. Others define SSBs as sweet drinks which contain any sweetener that can add calories to it (U.S. Department of Agriculture and U.S Department of Health and Human Services, 2010; Boston Public Health Commission (BPHC), 2011). Carbonated drinks, fruit-flavored drinks, sport drinks, and energy drinks are also categorized as SSBs, but it doesn't only limit to those kind of drinks (U.S. Department of Agriculture and U.S Department of Health and Human Services, 2010; Singh, *et al.*, 2015a; Singh, *et al.*, 2015b). In general, SSBs contain calories without give any nutritional benefits (Boston Public Health Commission (BPHC), 2011).

There are some kind of drinks which excluded from SSBs category. Fruit drinks which contain 100% juice without any added ingredients in it are categorized as non SSBs (Singh*, et al*., 2015a; Singh, *et al.*, 2015b). Carbonated drinks which contain 0 calorie and flavored-dairy products are also categorized as non SSBs (Keihner AJ, *et al.*, 2012). According to Harris *et al.* (2014), there are 3 kinds of drinks which are categorized as non SSBs. There are drinks which contain juice diluted with water with 0 calorie sweetener without added sugar (light fruit juices); drinks which contain 0 calorie and 0 gram added sugar (diet drinks); and any drinks which do not contain added sugar, including plain bottled water, 100% fruit juice/vegetables (other drink categories) (Harris, *et al.*, 2014).

Drink Categories	Definitions
Caloric carbonated drinks	Carbonated soft drinks which contain ≥ 2 gram added sugar per 8 oz serving.
Energy drinks	Caffeinated beverage products labeled by manufacturer as "energy drink" or "energy supplement". This category includes carbonated.
Fruit-flavor drinks	Fruit-flavored drinks with added sugar which contain no more than 50% fruit juice.
Tea/coffee	Include ready-to-serve drinks that are described as "iced tea" or "coffee beverage" and typically served cold.
Sport drinks	Drinks which marketed as intended to support physical activity.
Flavored drinks (without fruit juice)	Non-carbonated drinks described as "water beverage" on the product packaging.

Source: modification from Harris, *et al.* (2014)

Table 1: SSBs Categories.

According to Local Regulation of BPOM RI No. 1 2015 about food categories, "fruit juice" which defined as 100% juice without added sugar and can be diluted with water has different definition with "fruit-flavored drinks". In that regulation, fruit-flavored drinks are divided into 3, there are drinks which contain ≥35% fruit juice; 10-35% fruit juice; and <10% fruit juice.

According to Local Regulation of Health Minister No. 41 2014 about balanced nutrition, the amount of maximum added sugar consumption is 4 spoons sugar per day (Depkes RI, 2014). Other Local Regulation of Health Minister No. 30 2013 about products labeling showed that consumption sugar >50 gram (4 spoons), sodium >2000 mg (1 teaspoon), and fat >67 gram (5 spoons) per day will increase the risk of hypertension, stroke, diabetes mellitus, and heart attack (Depkes RI, 2014). High consumption of sugar causes weight gain and can also ended as diabetes mellitus type 2 (Depkes RI, 2014).

Methodology and methods

This quantitative study used cross sectional design. The research located at East Jakarta in a high school named SMA Negeri 48 which started from January until May 2016. The selection of the research location is based on high exposures to SSBs sales. Beside its canteen, there are so many convenient store, cafe, even supermarket around the building. Inclusion criteria in this research was all of 1st and 2nd year students (class X and XI) who are willing to participate as respondents. Exclusion criteria were 1st and 2nd year students who are not attending class at the time of collecting data and 1st and 2nd year students who has bad health condition at the time of collecting data which does not enable her/him to fill the questionnaire.

The minimum samples of this research was 154 respondents. This research was conducted to 168 respondents are selected by using quota sampling method. From total 16 classes of 1st and 2nd year students, 5 classes are selected randomly. Boys and girls are both included.

Self-administered Questionnaire and various sized bottles are used as the instruments of this research. The questionnaire contains of informed consent; identity of respondent; various questions about SSBs related to mass media exposure, accessibility, availability, family influence, peer influence, nutritional knowledge, attitude, physical activity, the habit of bringing drinkng water, and pocket money; and also semi-quantitative Food Frequency Questionnaire (FFQ). The various sized bottled are used to help respondents estimated the amount of SSBs they consume according to its categories and time (per day, week, month, or year) in semi-quantitative FFQ.

Data were collected by 2 enumerators per class who has trained before collecting data begin. First step, the enumerators were introduced themself and gave some explanation about the step of collecting data, and then gave the questionnaires to students. After that, 1 enumerator stood in front of class to guide students while filling the questionnaires. So, students can fill the questionnaire correctly and they finished together at the same time. The other enumerator was watching students while filling the questionnaire to see if someone got confused of the questionnaire. When students filled the semi-quantitative FFQ, various sized bottled are showed to help them estimate which size should they choose based on their habit of drinking SSBs. While students were filling the semi-quantitative FFQ, both of enumerators looked around class to check students' questionnaire one by one and make sure that there was no part filled incorrectly. After that, all of the questionnaires were collected by enumerators, and then students were given souvenirs.

Univariate analysis performed to get a global average intake of SSBs based on its categories and also frequency-distribution according to independent variables. Bivariate analysis performed used t-independent test to get information about which variables have a significant differences on the averages of SSBs consumption. Besides, there were T (t-test) value that showed which groups has higher SSBs consumption compared to the other group in one variable.

Discussion

The result showed that the average of SSBs consumption in general was 245.7 7 ± 208.4 mL/day. This average is higher compared to the global average intake of SSBs from research by Singh, *et al.* (2015a & 2015b) in 187 countries worldwide (137.2 mL/day). According to that research by Singh, *et al.* (2015a & 2015b) in region scale, the average of SSBs consumption among students of SMAN 48 (245.7 mL/day) is also higher compared to the average of SSBs consumption in East and Southeast Asian (142.0 mL/day); Sub-Saharan Africa (118.3 mL/day); North Africa and the Middle East (94.6 mL/day); and also South Asia, Australia and New Zealand, and Eurasia (47.3 mL/day). But, the average of SSBs consumption among students of SMAN 48 (245.7 mL/day) is lower compared to the average of SSBs consumption in United States-Canada and Latin America-Caribbean (260.2 mL/day).

Other studies about SSBs consumption are also found in many countries worldwide. The average of SSBs consumption among students of SMAN 48 (245.7 mL/day) is higher compared to the average of SSBs consumption in England (175.1 mL/day) among adolescents aged 16–19 years old by Lally, *et al.* (2011). Research by Loh DA, *et al.* (2016) in Malaysia showed that the average of SSBs consumption in Malaysia was 189.3 mL/day. The average of SSBs consumption among students of SMAN 48 (245.7 mL/day) is also higher compared to Malaysia. But, the average of SSBs consumption among students of SMAN 48 (245.7 mL/day) is lower compared to the average of SSBs consumption in United States (257.9 mL/day) (Shi, 2010).

SSBs Categories	Mean ± SD (mL/day)
Tea/coffee	152.7 ± 164.1
Fruit-flavored drinks	77.1 ± 129.1
Flavored drinks (without fruit juice)	65.7 ± 141.9
Sport drinks	56.9 ± 95.1
Caloric carbonated drinks	42.2 ± 63.9
Energy drinks	10.0 ± 51.3

Table 2: The Averages of SSBs Consumption Based on Its Categories (n=168).

SSBs Categories	Number of Respondents	
	Total (person)	Percentage (%)
Energy drinks	142	84.5
Flavored drinks (without fruit juice)	50	29.8
Sport drinks	32	19.0
Fruit-flavored drinks	28	16.7
Caloric carbonated drinks	20	11.9
Tea/coffee	14	8.3

Table 3: Unconsumed SSBs by Respondents Based on Its Categories (n=168).

According to Table 3, highest percentage of respondents who unconsumed SSBs was on energy drinks category and the lowest percentage was on tea/coffee category. That

means energy drinks was SSBs category which rarely consumed by respondents, while tea/coffee was SSBs category which often consumed by respondents.

Variables	Total (person)	Percentage (%)	The Averages of SSBs Consumption		
			Mean ± SD (mL/day)	T (t-test)	P Value
Sex					
Boys	69	41.1	308.2 ± 238.3	3.161	**0.002***
Girls	99	58.9	202.1 ± 170.1		
Mass Media Exposure					
High	95	56.5	275.3 ± 211.8	2.125	**0.035***
Low	73	43.5	207.1 ± 198.8		
Accessibility					
Easy	122	72.6	228.0 ± 206.3	-1.808	0.072
Uneasy	46	27.4	292.7 ± 209.0		
Availability					
High	67	39.9	318.0 ± 229.7	3.621	**0.000***
Low	101	60.1	197.7 ± 178.6		
Family Influence					
Influenced	126	75.0	261.6 ± 216.9	1.725	0.086
Non-influenced	42	25.0	198.0 ± 174.5		
Peer Influence					
Influenced	76	45.2	282.5 ± 215.7	2.104	**0.037***
Non-influenced	92	54.8	215.3 ± 198.3		
Nutritional Knowledge					
Good	126	75.0	230.4 ± 204.7	-1.654	0.100
Poor–Fair	42	25.0	291.5 ± 215.3		
Attitude					
Positive	70	41.7	200.3 ± 193.1	-2.418	**0.017***
Negative	98	58.3	278.1 ± 213.8		
Physical Activity					
Moderate–High	87	51.8	255.7 ± 190.7	0.644	0.521
Low	81	48.2	235.0 ± 226.7		
The Habit of Bringing Drinking Water					
Often	76	45.2	214.5 ± 171.6	-1.827	0.070
Rare	92	54.8	271.5 ± 232.3		
Pocket Money					
High	80	47.6	263.4 ± 214.1	1.048	0.296
Low	88	52.4	229.6 ± 203.0		

*P Value <0.05 = significant differences

Table 4: Results of Bivariate Analysis (n=168).

Table 4 showed that there was a significant difference on the average of sugar-sweetened beverages consumption according to sex, mass media exposure, availability, peer influence, and attitude.

Sex variable which has a significant difference and higher SSBs consumption among boys was supported by other studies. Wouters, *et al.* (2010) and Fauzia (2012) showed that there was a correlation between sex and carbonated drink consumption. Research by Wouters, *et al.* (2010) showed that there was a strong correlation between carbonated drink consumption among peer group and individual consumption among boys. Bremer, *et al.* (2010) and Miller *et al.* (2013) also showed that boys consumed more SSBs compared to girls.

Mass media exposure variable which has a significant difference and higher SSBs consumption among group with higher mass media exposure was supported by other studies. Grimm, *et al.* (2004) and Paes V *et al.* (2015) showed that there was a correlation between mass media exposure and SSBs consumption. Fauzia (2012) showed that there was a correlation between mass media exposure and carbonated drink consumption. Even Battram, *et al.* (2016) showed that drinks commercial is a dominant factor that affected drinks preference among students. Costa *et al.* (2012) showed that there was a direct correlation between commercial interest and products purchasing. Keihner AJ, *et al.* (2012) showed that adolescents with television in their room consume ¼ times more SSBs.

Availability variable which has a significant difference and higher SSBs consumption among group with higher availability was supported by other studies. Grimm, *et al.* (2004), Ezendama, *et al.* (2010), Lippevelde, *et al.* (2012), Ansem, *et al.* (2014), Watts (2014), and Bjellanda, *et al.* (2011) showed that there was a significant difference between SSBs consumption among adolescents and availability of SSBs at home. Even Bogart, *et al.* (2013) showed that availability is a dominant factor of SSBs consumption. Hebden, *et al.* (2013) showed that students who have SSBs at their home, 5 times abler to become a high consumer of SSBs.

Peer influence variable which has a significant difference and higher SSBs consumption among influenced group was supported by other studies. Wouters, *et al.* (2010) showed that there was a correlation between peer influence and SSBs consumption. Skriptiana (2009) and Fauzia (2012) showed that there was a correlation between peer influence and carbonated drinks consumption. This may be caused by adolescents' time that are mostly spent together with friends Brown, *et al.* (2011). Fauzia (2012) also showed that students with peer influenced has chance 4.05 times abler to become a high consumer of SSBs.

Attitude variable which has a significant difference and higher SSBs consumption among negative group was supported by other studies. Negative attitude means students has an incorrect attitude about SSBs. For example, they often choose SSBs instead of water when thirsty. Ariani (2012) showed that there was a correlation between attitude and SSBs consumption. Horst, *et al.* (2007) and Fauzia (2012) showed that there was a correlation between attitude and carbonated drinks consumption. Fauzia (2012) also showed that students who has negative attitude about SSBs, 7.39 times abler to become a high consumer of SSBs.

Table 4 also showed that there was no significant difference on the average of sugar-sweetened beverages consumption according to accessibility, family influence, nutritional knowledge, physical activity, the habit of bringing water, and pocket money.

Accessibility variables which has no significant difference may be caused by the questionnaire that has no question about school accessibility. SSBs accessibility among students at school were same. Besides, students' time are mostly spent at school. So, it has no significant effect at SSBs consumption from the questions in questionnaire about accessibility. Not really different from accessibility, family influence variable also has no significant effects at SSBs consumption because students' time are mostly spent at school.

Nutritional knowledge variable which has no significant difference may be caused by the process of collecting data. Some students still able to ask another friend while filling the questionnaire at this part. Physical activity which has no significant difference may be caused by the homogeneous activity among students. Because students' time are mostly spent at school, there was just a little difference at physical activity, especially during weekdays which take most of their time. The habit of bringing drinking water which has no significant difference may be caused by the unavailability of free drinking water at school. So, it was almost impossible for those who already bring drinking water to not purchase extra drinks during school's time. Pocket money which has no significant difference may be caused by the range of SSBs' prices. SSBs with various prices from the cheapest until the expensive one are sold everywhere, including at school's canteen.

Conclusions

Supports from various authorities related to SSBs sales policy and free drinking water supply in public places, especially school, are needed to reduce SSBs consumption. From this research, people can get information about factors related to SSBs consumption, so they can pay attention to some factors if they are willing to reduce SSBs consumption. This research has some limitations. This research still used cross sectional, also only used univariate and bivariate analysis, and sampling method used was quota sampling. The location of the research has limitation at the time of collecting data, so we could not choose respondents randomly from all 1st and 2nd year students by using systematic random sampling. So respondents selected randomly by classes.

There are some suggestions that we found from this research to encourage people reduce SSBs consumption.

For students

- ✓ Please avoid using SSBs company as events' sponsor.
- ✓ Do not be a follower in purchasing SSBs. If you are determined to reduce SSBs, be consistent.
- ✓ Bring your own drinking water. It will be better if you choose tumbler or bottle water that can be used many times, instead of choose disposable plastic bottle.
- ✓ Be selective. You should read the nutrition facts and consider the serving size if you really want to purchase SSBs.
- ✓ Only consume sport or isotonic drink when it is really needed. For examples, if you are in a competition and need rapid hydration.

For Parents

- ✓ Do not provide SSBs at home.
- ✓ Do not make sugary drink at home as habit.
- ✓ Try to make infused water, instead of sugary drink. Infused water is a drink which is made from fruit slices, vegetables, or herbs immersed in cold water and usually put in refrigerator for some hours or overnight before it is consumed.

For Schools

- ✓ Provide free drinking water supply at school.
- ✓ Limit the sales of SSBs at school's canteen.

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Factors Related to Estimated Maximal Oxygen Uptake (VO_2Max) among Faculty of Health Sciences Students in Universitas Indonesia 2016

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The Asian Undergraduate Research Symposium 2016
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Abstract

Estimated VO_2Max (Volume Oxygen Maximum) value, which is the maximum oxygen capacity a body can use in a minute, is regarded as the best indicator to measure one's level of cardiorespiratory fitness. The objective of this research is to get information about the mean value of estimated VO_2Max among Faculty of Health Sciences (Rumpun Ilmu Kesehatan) Students in Universitas Indonesia and its correlation with sex, physical activity, body mass index, body fat percentage, micro and macronutrient intake, sleep quality, also stress level.

This research is a cross-sectional study with 122 samples. Estimated VO_2Max value was measured by using Queens College Step Test method. The mean value from all samples was 38.9±6.9 mL/kg/min which differs significantly between each sex group (male = 43.9±7.9 mL/kg/min on men and women = 35.4±2.8 mL/kg/min ; p value<0.05). Bivariate analysis showed that there are positive significant correlation between physical activity, energy intake, protein intake, fat intake, carbohydrate intake, vitamin B1, B2 and Fe intake with estimated VO_2Max value, respectively. While it showed negative significant correlation between body fat percentage with estimated VO_2Max value. Bivariate analysis also showed that there are no significant correlation between BMI, vitamin C intake, sleep quality, and stress level with estimated VO_2Max value, respectively.

Keywords: VO_2Max, Queens College Step Test, Students, Physical Activity, Intake

Introduction

Estimated VO_2Max (Volume Oxygen Maximum) value, which is the maximum oxygen capacity a body can use in a minute (Hoeger and Hoeger, 2011; Romero-Fallas, Soto-Arias, and Moncada-Jimenez, 2012), is regarded as the best indicator to measure one's level of cardiorespiratory fitness (Hoeger and Hoeger, 2011). Cardiorespiratory fitness can affect overall health, life quality, life expectancy, and also daily productivity (Wuest and Fisette, 2012).

Researches about VO_2Max have been done in many countries. Previous findings in 10 cities across Europe showed that the average of estimated VO_2Max among girls in adolescents age group is 37.1 mL/kg/min, which still is not categorized as good based on Hoeger and Hoeger (2011) fitness category for stated age group (Ortega, *et al*., 2011). Previous findings among college students in United States also showed that the average of estimated VO_2Max value among adolescents and/or college students had not reached good cardiorespiratory fitness category (Lepp, *et al.*, 2013).

Previous findings in Indonesia that has been done towards college students who undergo regular physical training showed that those college students' average estimated VO_2Max value also had not been categorized as good yet (below 39 mL/kg/min for female and below 44 mL/kg/min for male) (Hoeger and Hoeger, 2011; Trisnasari, 2015). Next findings by Sinamo (2012), whose research had been done towards college students majoring Nutrition Science in Universitas Indonesia, showed that the average of estimated VO_2Max value is 29,6 ± 5,9 mL/kg/min.

Previous findings by Sinamo showed that part of Faculty of Health Sciences (*Rumpun Ilmu Kesehatan*) in Universitas Indonesia still has low average of estimated VO_2Max value. In addition to that, Faculty of Health Sciences (*Rumpun Ilmu Kesehatan*) students in Universitas Indonesia will be the next medical staffs and health teams who will collaborate to serve patients and public, and also will be needed in developing health in Indonesia, for which each individual health status should be maintained since earlier age. Therefore, it is important to do further research on estimated VO_2Max value (as a health related fitness indicator) towards Faculty of Health Sciences (*Rumpun Ilmu Kesehatan*) students in Universitas Indonesia.

This research is aimed to get information about the mean value of estimated VO_2Max among Faculty of Health Sciences Students and its correlation with sex, physical activity, body mass index, body fat percentage, micro and macronutrient intake, sleep quality, also stress level.

Literature Review

Cardiorespiratory fitness, indicated by VO_2Max (Volume Oxygen Maximum) value, is regarded as the most important component among all health related fitness (Wuest nad Fisette, 2012). Good cardiorespiratory fitness can decrease cardiovascular diseases risks, increase daily productivity, also increase life quality and life expectancy (Wuest and Fisette, 2012).

VO_2Max value is the maximum oxygen capacity a body can use in a minute while doing physical activity (Hoeger and Hoeger, 2011). VO_2Max, with mL/kg/min as its unit, is the best indicator that can be used to determine individual's cardiorespiratory fitness (Hoeger and Hoeger, 2011).

VO_2Max can be measured directly and indirectly. Direct measurement (laboratory measurement) of VO_2Max is a costly method which needs long time to be done and trained personnel so it is considered not really practical to do (Nieman, 2011). Indirect measurement of VO_2Max can be done with much more easy methods which still considered valid, as their validities are already confirmed beforehand, to substitute direct measurement (Nieman, 2011).

Queens College Step Test is one of the indirect tests that can measure estimated VO_2Max value which was developed by McArdle, Katch, dan Katch (1994). The instruments needed for this tests are 16¼ inch bench, metronome (set at 96 bpm for males and 88 bpm for females) and a stopwatch (Hoeger and Hoeger, 2011; Nieman, 2011). Participants are expected to step up and down the bench following the rhythmic on the metronome for three minutes and their heartbeat are to be counted for 15 seconds afterwards (Hoeger and Hoeger, 2011; Nieman, 2011). The time gap between the end of the stepping and the beginning of the heart beat counting is five seconds (Hoeger and Hoeger, 2011; Nieman, 2011). Thus, the heart beat counting is inserted to this following equation to get the estimated VO_2Max value (McArdle, Katch, dan Katch, 1994; Nieman, 2011).

Estimated VO_2Max for Males:
VO_2Max (mL/kg/min) = 111.33 – (0.42 x Heart Rate)

Estimated VO_2Max for Females:
VO_2Max (mL/kg/min) = 6.81 – (0.1847 x Heart Rate)

(*Queens College Step Test)*

Figure 1: Queens College Estimated VO_2Max Equation

There are some factors correlated with VO_2Max, such as sex, physical activity, body mass index, body fat percentage, macronutrient intake, micronutrient intake (Vit. B_1, Vit. B_2, Vit. C, Iron) sleep quality, also stress level. Tammelin (2005) in previous study about physical activity stated that there are strong correlation between high level physical activity and good cardiorespiratory level (Zimmermann-Sloutkiss *et al*., 2010). Sex is also a factor that correlated with VO_2Max (Hoeger and Hoeger, 2011; Trisnasari, 2015). Another findings in Korea showed that Body Mass Index (BMI) is also a factor that is correlated with VO_2Max (Kim dan So, 2013).

Another findings by Scott (1992) showed that body fat percentage is also a factor that is correlated to VO_2Max. Nutrient intake, as it is showed in previous research by Cuenca-Garcia, *et al.* (2012) is also correlated to VO_2Max. Lee and Lin (2007) found that sleep quality is also correlated to VO_2Max, where in their research it showed that a group of women who have bad sleep quality tends to have low level of fitness. Another research also showed that women and men with higher psychologic stress

tends to have less physical activity (Muhsen, *et al.*, 2010), which resulting in decreasing level of fitness (Countryman, *et al.,* 2013).

Methodology

This research is a cross sectional research which aimed to determine whether or not there are any correlation between independent variables (sex, physical activity, body mass index, body fat percentage, macronutrient intake, micronutrient intake (Vit. B_1, Vit. B_2, Vit. C, Iron) sleep quality, also stress level) with dependent variable VO_2Max.

Data collecting was done in Faculty of Health Sciences in Universitas Indonesia from April to May 2016. Population target in this research is all college student currently studying in Faculty of Health Sciences in Universitas Indonesia at that time. Faculty of Health Sciences in Universitas Indonesia consisted of Faculty of Medicine, Faculty of Dentistry, Faculty of Public Health, Faculty of Nursing, and Faculty of Pharmacy. Population study in this research is college student in regular program starting from batch 2014 to 2015.

Eligible subject was then determined by using inclusion and exclusion criteria. Inclusion criteria is active college students in regular program in Faculty of Health Sciences batch 2014 to 2015 who aged more than 18 years old at that time. The exclusion criteria is college students who was sick, have some cardiac condition, or have physical activity limitation do to certain condition which can disturb the VO_2Max test. After that, sample was chosen by using stratified random sampling method with proportional sampling allocation among college students in regular program of Faculty of Health Sciences batch 2014 to 2015.

The data that used for this research was primary data. Estimated VO_2Max value was measured by using Queens College Step Test. Sex, physical activity, sleep quality, and stress level data were gathered by using questionnaire. Body fat percentage data were gathered by using *Bioelectrical Impedance Analysis* (BIA). Body mass index data were gathered by measuring body weight and body height. Finally, the micro and macro nutrient intake data were gathered by collecting dietary history using 2x24 Hours Recall method.

Discussion

The number of total respondents in this research is 122 respondents. Based on the sex, the respondents consist of 73 females (60%) and 49 males (40%). The difference of estimated VO_2Max value between males and females are further explained on table 1.

Variables	Sex	n	Mean±SD	p value
Estimated VO_2Max value	**Male**	49	43.9±7.,9	0.0001*
	Female	73	35.4±2.8	

Table 1: Average Differences of Estimated VO_2Max Value Based on Sex (n=122)

Based on the table 1, the result showed that the average estimated VO_2Max for males almost reached good category for individuals aged below 29 years old, for females, it

is showed that the average of estimated VO_2Max value has not categorized as good yet. As for the difference, it is showed that there are significant difference between male and female estimated VO_2Max value (p value < 0.005).

The higher estimated VO_2Max for males in compared to females are related to the higher haemoglobin levels on males, the lower fat level, and the bigger heart size the males have compared to females (Hoeger and Hoeger, 2011). The lower fat level on males resulting on the more muscle mass males have which can produce more aerobic energy than women (Hoeger and Hoeger, 2011). Males also have approximately 5 – 10 % more haemoglobin concentrate than women which resulting in more oxygen circulation while doing physical activity which affect the VO_2Max to be more than the females' (Katch, McArdle, dan Katch, 2011).

Correlation results between independent variables and dependent variables are further showed in table 2.

Independent Variables	Dependent Variable (Estimated VO_2Max Value)		
	r	R^2	*P value*
Physical Activity	0.461	0.212	0.0001*
Body Mass Index	-0.022	0.0001	0.809
Body Fat Percentage	-0.505	0.255	0.0001*
Energy Intake	0.272	0.074	0.002*
Protein Intake	0.217	0.047	0.017*
Fat Intake	0.179	0.032	0.049*
Carbohydrate Intake	0.273	0.075	0.002*
Vitamin B_1 Intake	0.288	0.083	0.001*
Vitamin B_2 Intake	0.253	0.064	0.005*
Vitamin C Intake	0.005	0.0001	0.957
Iron/Fe Intake	0.217	0.047	0.016*
Sleep Quality	0.103	0.011	0.257
Stress Level	0.110	0.012	0.230

**Correlation is significant at 0.05 level*

Table 2: Correlation Test Result between Independent and Dependent Variables (n=122)

Bivariate analysis (table 2) showed that there are positive significant correlation between physical activity, energy intake, protein intake, fat intake, carbohydrate intake, vitamin B_1, B_2 and Fe (Iron) intake with estimated VO_2Max value, respectively. While it showed negative significant correlation between body fat percentage with estimated VO_2Max value. Bivariate analysis also showed that there are no significant correlation between BMI, vitamin C intake, sleep quality, and stress level with estimated VO_2Max value, respectively.

Physical activity is one of the variables that is showed to have significant correlation with estimated VO_2Max value. Positive significant correlation means that higher the level of physical activity individuals have, the higher the estimated VO_2Max value individuals tend to be have. Physical activity that one's done regularly can strengthen the cardiac muscles to pumps blood throughout the body which can result in the more oxygen the body can received in one pump (Corbin, *et. al.*, 2008). Another variables which have positive significant correlation is energy and fat intake. Previous findings also showed that respondents with higher energy intake have higher fitness levels than the other with lower energy intake with significant difference (p value <0.05). More energy intake, which also affected by fat, will affect body to provides more energy while doing physical activity so it will not be disturbed and the body will not get tired easily (Corbin, *et al*., 2008).

Protein intake is also a variable that have significant correlation with estimated VO_2Max value. Protein produce haemoglobin in human body. The more protein individual's have, the more haemoglobin can be produced which can affect the oxygen circulation in the body (Katch, McArdle, dan Katch, 2011). Carbohydrate as the main source of energy when doing physical activity is also has significant correlation with estimated VO_2Max value (Kenney, Wilmore, dan Costill, 2012). Glycogen, which is produced by Carbohydrate can prevent fatigue when doing physical activity with high intensity (Kenney, Wilmore, dan Costill, 2012).

Micronutrient intake (vitamin B_1, B_2 and Iron) has positive significant correlation with estimated VO_2Max value. Vitamin B1 is needed in fat metabolic, protein metabolic, and also takes a main part in carbohydrate metabolism (Almatsier, 2009). Wardlaw stated that Vitamin B2 is on of micronutrient that can increase cardiorespiratory fitness (Komala, 2013). Iron is function as component structure of myoglobin which can store oxygen in muscle tissue (Kenney, Wilmore, dan Costill, 2012).

Body fat percentage has negative significant correlation with estimated VO_2Max value. This correlation means that the lower body fat percentage an individual has, the higher estimated VO_2Max value an individual tends to has. Excess body fat can burden the work of cardio thus disturb the oxygen pickup from muscles. The higher the body fat also result in the lower muscle mass which makes the total aerobic energy lower (Hoeger and Hoeger, 2011).

Conclusions

Positive significant correlation between physical activity, energy intake, protein intake, fat intake, carbohydrate intake, vitamin B_1, B_2 and Fe intake with estimated VO_2Max value, respectively, encourage students to increase their physical activity and micronutrient intake as well as taking care of their macro nutrient intake to make sure that those are adequate. It is also advised to do nutritional status routine check up.

Negative significant correlation between body fat percentage with estimated VO_2Max value, showed that students need to take care of their body fat percentage to not be over because the higher percentage of body fat individual has, the lower the value of estimated VO_2Max tends to be.

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Vegetables and Fruits Intake as a Dominant Factor of Hypertension in Central Office PT.Pos Indonesia Employees, Jakarta 2016

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Abstract
Hypertension is a major public health problem and cardiovascular risk facor. The purpose of this study was to find dominant factor of hypertension in Central Office PT.Pos Indonesia, Jakarta. This research was a cross sectional study with 132 respondents. Data were collected from February to June 2016. Data of blood pressure were collected with sphygmomanometer and stethoscope, nutritional status with anthropometry, fat body percentage with *Bioelectrical Impedance Analysis* (BIA), stress with *Perceived Stress Scale* (PSS) questionnaire, quality and duration of sleep with *Pittsburgh Sleep Quality Index* (PSQI) questionnaire, fitness with step test YMCA 3 minutes, physical activity with *Global Physical Activity Questionnaire* (GPAQ), food intake with recall 3x24 hours. Data were processed with chi square, and logistic regression. Dominant factor of hypertension in this research is vegetables and fruits intake (p value=0.017), someone with very low vegetables and fruits intake will risk 7.2 more to have hypertension than someone with enough vegetables and fruits intake. It is suggested that employee have to decrease food which contain of high sodium, increase vegetables and fruits intake, and enhance physical activity.

Keywords: employee; food intake; hypertension; physical activity; vegetables and fruits intake

1. Introduction

Hypertension is a major public health problem[1] and main risk factor for cardiovascular diseases[2]. In 2011, approximately 54% stroke, 47% ischemic heart disease, and 25% other cardiovascular diseases are caused by hypertension[3]. Half of hypertension prevalence in the world is in Asia Pasific[3].

Uncontrolled hypertension in the world rising significantly from 1980 until 2010 because of growth and aging population in the world[2]. In 2014, global hypertension prevalence has reached approximately 22%[2]. In 2025, global hypertension prevalence is predicted increase up to 60%[4]. Hypertension prevalence in Indonesia in 2013 has reached 26,5%[5].

Hypertension is a condition when blood pressure rising chronically[5]. High blood pressure caused by heart pumps harder for fulfill nutrition and oxygen needed in body[5]. Hypertension is condition when systolic pressure and or diastolic pressure equal or more than 140/90 mmHg[6].

There are two types of factors causing hypertension, which are modified and unmodified factors[7]. Some factors related to hypertension are body mass index (BMI), fat body percentage, cardiovascular fitness, physical activity, smoking, stress, sleep duration, sleep quality, age, genetic, vegetables and fruit intake, sodium intake, and sex.

2. Method

2.1 Participants

Study has done in Head Office PT.Pos Indonesia, Jakarta from February until June 2016. This study has done on 132 respondents (age range: 19-54 years old) who employed in Pos Indonesia and spend many hour in front of computer. Analyze focused on finding dominant factor on hypertension. Analyzed that used are univariate, bivariate, and multivariate. Univariate analyzes used to get data distribution, average, standard deviation, minimum and maximum. Bivariate analyzes that using chi square is used to get proportion difference between independent variable and dependent variable. If *p value* <0,05, it proved that there is relation between independent variable with dependent variable statistically. Multivariate analyze that use logistic regression is used to get dominant factor. Variable with *p value* <0,05 and have highest Odds Ratio is a dominant factor.

2.2 Procedures

Blood Pressure

Data has taken by midwife whose used sphygmomanometer and stethoscope. Data has taken twice and minimal 1 hour after last eating time. If result from the first and second measuring has differences more than 10 mmHg, third measuring must done. Data that used is average from two measuring with least difference. Cut off hypertension is ≥140 mmHg for systolic and ≥90 mmHg for diastolic. If blood pressure less than them, it will categorize as normotensive[6].

Fat Body Percentage and Body Mass Index

Fat body percentage has taken by used Bioelectrical Impedance. Body fat percentage classified into 2 category, they are have hypertension risk, and have no hypertension risk. Cut off point body fat percentage for male and female is different. For women, if body fat percentage ≥34.1 categorized as have risk of hypertension and if less than 34.1 categorized as have no risk of hypertension. For male, if body fat percentage ≥20.4 it will categorized as have risk of hypertension and if less than that, it will categorized as have no risk of hypertension[8].

Body mass index has taken by used height and weight. Calculation to get BMI data used Quatelet Index.

$$BMI = \frac{weight\ (kg)}{height^2\ (m^2)}$$

BMI categorized into 3 category, there are obesity, overweight, and normal. Cut off point for each category is ≥30 kg/m^2 for obesity, 25 kg/m^2-29.9 kg/m^2 for overweight and 18.5 kg/m^2 -24.9 kg/m^2 for normal[5].

Cardiovascular Fitness

Cardiovascular fitness has done by used YMCA 3-minutes Step Test. After 3 minutes step test, heart rate respondent will measured for one minute with stopwatch. YMCA step test has done by used a 12-inch box and metronome with 96 beats per minute.

Physical Activity

Physical activity data has taken by used Global Physical Activity Questionnaire (GPAQ). Using MET as cut off point in categorized physical activity. Low physical activity if MET total is <600 MET, have moderate physical activity if 600-2999 MET, and have high physical activity if MET ≥3000[9].

Smoking status, age, sex, and genetic

Data has taken by questionnaire. Age data classified into two classification, they are have risk on hypertension and non-risk. Respondent will categorized have hypertension risk if ≥45 years old and will categorized as have no risk if <45 years old. Sex data will classified into two category, there are female and male. Genetic data has taken by ask about hypertension on their parents. Respondent will categorized as have hypertension risk genetically if one or both of their parents have hypertension.

Stress

Stress data has done by used Perceived Stress Scale (PSS). Questionnaire content of 10 questions. There are 4 answers for each question, never, almost never, rarely, often, and very often. Stress data categorized into 3 category, there are high, moderate, and low. High stress if PSS Score ≥20, moderate if PSS score 13-19, and low stress if <13[10].

Duration and Quality of Sleep

Data has taken by used Pittsburgh Sleep Quality Index (PSQI). The answer for each question has 0-3 point.

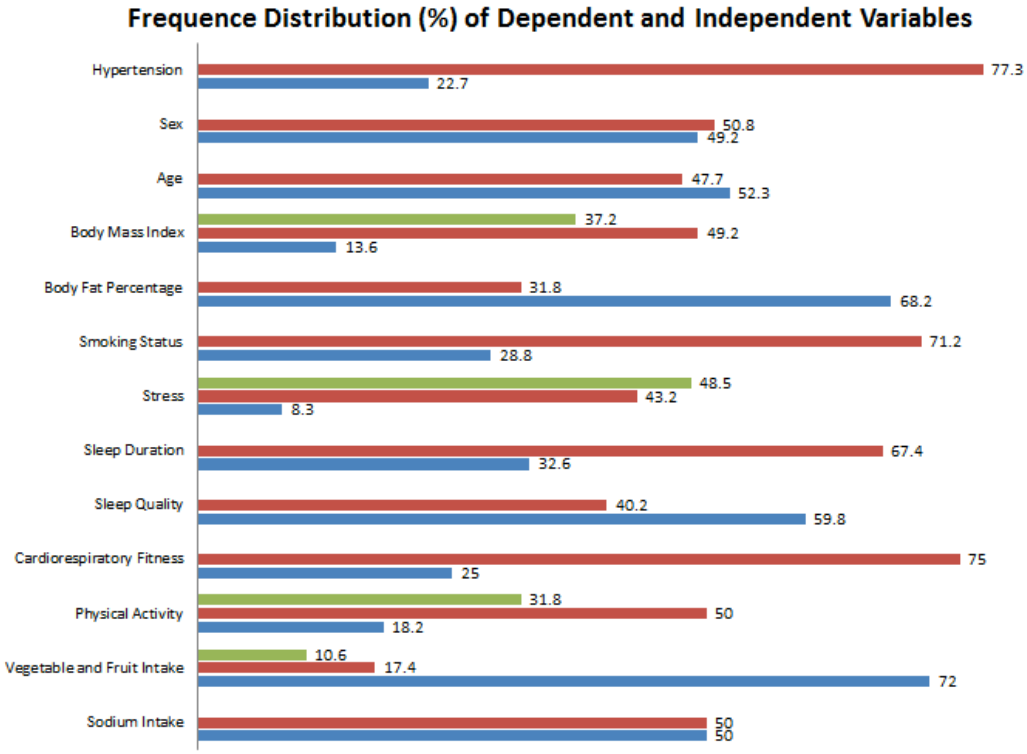
Sodium, Vegetable and Fruit Intake

Data has taken by used recall 3x24 hours. Respondent will ask about what they eat from 00.00 until 23.59 the day before.

3. Result

3.1 Univariate Analyze

Univariate analyze has done to get information about frequency distribution from independent variables and dependent variable.



Employees that have hypertension is 22,70% and 77,30% is normotensive. Sex distribution in respondents is almost balance, 49,20% is female and 50,80% is male. Age data classified into two classification, they are have risk on hypertension and non-risk. Respondent will categorized have hypertension risk if ≥45 years old and will categorized as have no risk if <45 years old. Study showed that respondents who have hypertension risk is higher than have no risk based on age. Respondents who have hypertension risk is 52,30% and have no hypertension risk is 47,70%. Study showed that 38,60% have obesity, 25% have overweight, and 36,40% have normal body mass index. Risk hypertension can predicted by body fat percentage. Based on cut off point body fat percentage that have risk on hypertension, most of respondents have risk on hypertension. Respondents who has hypertension risk based on body fat percentage is 68,20% and 31,80% have no hypertension risk.

Respondents who is smoking is 28,80% and no smoking is 71,20%. Study showed that respondents who have high stress is very low. Respondent who have high stress is 8,30%, moderate stress is 43,20%, and low stress is 48,50%. Sleep duration categorized into two classification. Respondents who have less sleep duration is

32,60% and have adequate sleep duration is 67,40%. Respondents who have low sleep quality is 59,80% and have good sleep quality is 40,20%. Respondents who have good cardiorespiratory fitness is 75% and low cardiovascular fitness is 25%. Respondents who have good physical activity is 31,80%, moderate 50%, and low is 18,20%.

Study showed that respondents who have adequate sodium intake and non-adequate sodium intake is same, 50%. Respondents who have adequate vegetables and fruits intake is 10,60%, 17,40% have low vegetables and fruits intake, and 72% have very low vegetables and fruits intake.

3.2 Bivariate Analyze

Analyze has done to know variables that relate statistically to hypertension.

Variable	Blood Pressure				Bivariate Analyze	
	Hypertension		Normotensive		P value	Odds Ration
	n	%	n	%		
Sex						
Female	11	16.90	54	83.10	0.115	-
Male	19	28.40	48	71.60		
Age						
Risk	17	24.60	52	75.40	0.583	-
No Risk	13	20.60	50	79.40		
Genetic						
Yes	13	40.60	19	59.40	0.008	3.341 (1.389-8.033)
No	17	17.0	83	83.0		
Body Mass Index						
Obesity	8	44.4	10	55.60		5.733 (2.622-20.263)
Overweight	16	24.60	49	75.40	0.02	2.340 (0.841-6.514)
Normal	6	12.2	43	87.80		
Body Fat Percentage						
Risk	25	27.80	65	72.20	0.034	2.846 (1.004-8.065)
No Risk	5	11.90	37	88.10		
Smoke Status						
Smoker	11	28.90	27	71.10	0.286	-
Non-Smoker	19	20.20	75	79.80		
Stress						
High	2	18.20	9	81.80		
Moderate	15	26.30	42	73.70	0.684	-
Low	13	20.30	51	79.70		
Sleep Duration						
Less	17	39.50	26	60.50	0.02	3.882 (1.636-8.929)
Moderate	13	14.60	76	85.40		
Sleep Quality						
Low	14	17.70	65	82.30	0.096	-
Good	16	30.20	37	69.80		
Cardiovascular Fitness						
Low	13	39.40	20	60.60	0.011	-
Good	17	17.20	82	82.80		
Vegetables and Fruits Intake						
Very Low	17	17.90	78	82.10		
Low	8	34.80	15	65.20	0.105	-
Moderate	5	35.70	9	64.30		
Sodium Intake						
High	21	31.80	45	68.20	0.012	2.956 (1.234-7.077)
Moderate	9	13.60	57	86.40		

Study showed that genetic, body mass index, body fat percentage, sleep duration, and sodium intake is related to hypertension statistically. Factor dominant has done by multivariate analyze, regression logistic.

Final Multivariate Analyze Stage

Variabel	*P Value*	OR
Genetic	**0,003**	**6,607**
Sleep Duration	**0,001**	**7,00**
Sleep Quality	**0,011**	**0,234**
Cardiovascular Fitness	**0,02**	**4,553**
Body Fat Percentage	0,364	1,863
Body Mass Index 1	0,099	0,234
Body Mass Index 2	0,126	0,360
Sodium Intake	0,054	3,075
Vegetables and Fruits Intake 1	**0,017**	**7,204**
Vegetables and Fruits Intake 2	0,306	2,482

Analyze showed that variables that have p value <0.05 are genetic, sleep duration, sleep quality, cardiovascular fitness, and vegetables and fruits intake. It means that they have association to hypertension. Finding dominant factor is based on p value and OR. Variable that have p value<0.05 and have the greatest OR is a dominant factor. Analyze showed that vegetables and fruits intake is a dominant factor of hypertension. This is based on p value <0.005 and the highest OR (7.204).

4. Discussion

The goal of this study is to find dominant factor of hypertension. Multivariate analyze showed that vegetables and fruits consumption is a dominant factor of hypertension. Genetic, sleep duration, sleep quality, and vegetables and fruits intake are variables that have p value <0.05. So, there are dominant factor candidate for hypertension. Beside based on p value, dominant factor examined by Odds Ratio (OR). Variables that have the greatest OR is a dominant factor. Vegetables and fruits intake variable has the greatest OR which is 7,204, so it means that vegetables and fruits intake is a dominant factor of hypertension in Head Office PT.Pos Indonesia.

Fiber consumption for four weeks can increase insulin secretion in overweight non diabetic individual[11]. Antioxidant from vegetable and fruit can decrease endhotelium malfunction that caused by high fat food consumption[12]. Vegetable and fruit contain antioxidants that have protective function to hypertension. Antioxidant like ascorbate acid can normalize endhotelium function through normalize amount of oxide nitric (vasodilator endhotelium)[12]. Vitamin E, B, and D in vegetable and fruit also associate with decrease risk of obesity and cardiovascular[13]. Vitamin C and E can improve endhotelium function through vasodilatation of endhotelium and decrease arteriosclerosis[14]. Other mechanism explained that Monounsaturated Fatty Acid (MUFA) which is enriched in vegetable and fruit can decrease insulin resistance, so MUFA consumption can decrease blood pressure[12].

5. Summary

Respondents that have hypertension in Head Office PT.Pos Indonesia is 22,70%. Variables that proved have relation significantly to hypertension are genetic, body mass index, fat body percentage, sleep duration, cardiovascular fitness, and sodium intake. Vegetable and fruit intake proved as a dominant factor of hypertension. Vegetable and fruit contain of fibers, antioxidants, and MUFA that each of them have a preventive role to hypertension. Fiber can increase insulin secretion[11], antioxidants can decrease endhotelium malfunction and normalize endhotelium function[12] and MUFA can decrease insulin resistance which can decrease blood pressure[12].

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Finding the Root Substance: Religious Classification of the Thought of Liu Zhi

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Abstract
During the Qing dynasty in China, starting particularly in the 17th century, Hui Muslim scholars began to develop a distinctive Chinese reinterpretation of Islam based on the preceding Neo-Confucian tradition. In the early 18th century, the work of several such scholars was collected in the Han Kitab, a volume compiled by and primarily authored by Liu Zhi. Liu Zhi's approach to Islam is almost exclusively metaphysical, emphasizing the unity of all being, and replaces the formal signifiers of Islam with native Chinese terms. Scholars such as Sachiko Murata and David Lee claim that this is part of a process of "contextualization", by which "dynamic equivalence" with the Arabic and Persian source texts is established. I argue, however, that the substitution of terms with established and rich meaning in the traditions of Chinese thought constitutes "sinicization" - in other words, that this substitution results in such a radical departure from the meaning of the source text that it results in an absorption of some Islamic concepts by the system of Neo-Confucianism, rather than a simple adaptation of Islam into Chinese. I defend this thesis by referring to Liu Zhi's works, particularly *Nature and Principle in Islam*.

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I. Introduction

My paper will contrast the Neo-Confucian Islam developed in the 17th and 18th centuries in China, particularly by the scholar Liu Zhi, with the general picture of Islam, and assess the extent to which this reinterpretation forces a broadening of Islam well beyond the fundamental framework laid down by Muhammad.

During the Qing dynasty in China, starting particularly in the 17th century, Muslim scholars of the Hui ethnic group began to develop a distinctive Chinese reinterpretation of Islam based on the preceding Neo-Confucian tradition. Their works coalesced into the Han Kitab canon. Most prominent among these scholars was Liu Zhi (c. 1670 - c. 1724).

Sachiko Murata has studied Chinese Islam more extensively than any other contemporary scholar, and has produced respected translations of the writings of Liu and his contemporaries. In doing so, her work has revealed a potential rift between mainstream, Abrahamic Islam and this Neo-Confucian variant. Cedric Schurich describes the conception of Islam endorsed by Murata thus: "...before man can start to cultivate the inner virtues, he must learn to follow the bread and butter dos and don'ts as set down in Islam and elaborated by the Sharia."[1]

This view of Islam is very far removed from that found in Liu Zhi. Through an examination of his *Root Classic*, part of his treatise on *Nature and Principle in Islam* (天方性理, *tianfang xingli*), I will show that Liu approaches Islam from a metaphysical angle, emphasizing the oneness of Being, and largely ignoring Sharia and other elements of orthodoxy. His orientation is at least as congruous with the Three Teachings (三教, *sanjiao*) of Confucianism, Daoism, and Buddhism as with the Islam informed by the Qur'an, hadith, sunnah, and Shariah. If Liu breaks with the historical foundations of Islam, mostly ignores the regulatory and devotional elements of the religion, and adopts a metaphysical view of the world undistinguished from that of the Neo-Confucian view of the time, then to what extent can it actually be considered Islamic? I will argue that including such developments as those of Liu Zhi force a broadening of Islam to the point of no longer being a useful designation.

II. The theory of dynamic equivalence

Murata's primary argument for regarding the Han Kitab as fundamentally Islamic is based on the theory of "dynamic equivalence". "Liu Zhi's translation is the dynamic equivalent meaning of the text," David Lee writes of her thesis, "achieved by using Neo-Confucian terms and concepts as a linguistic tool".[2] Murata herself characterizes her project as one of assessing "the intrinsic value of the philosophical and theological ideas

[1] Cedric Schurich, "Review of Murata, *The Vision of Islam.*" *Journal of Qur'anic Studies* 3, no. 1 (2001): 110-113.
[2] David Lee. *Contextualization of Sufi Spirituality in Seventeenth- and Eighteenth-Century China: The Role of Liu Zhi (c.1662-c.1730)* (Eugene, OR: Pickwick Publications, 2015).

that inform the writings".[3] Another way of representing this is to hold that Liu "contextualized" Islam, as opposed to sinicizing it.

This is precisely the approach that I am attempting to counter here. My contention is that the use of Neo-Confucian terms, let alone its concepts, already results in a significant difference in subjective experience for a Hui Muslim. Even if Liu intended a correspondence with Islamic concepts, such concepts cannot be understood solely through the use of terms that have an entirely different lineage. The very existence of a dynamic equivalence also seems to be ill-supported, if not entirely unsubstantial; if one does classify Liu's work based on its root content rather than its terminology, one can at least make a strong argument that it still has more in common with preceding Chinese thought than with Islam.

The dynamic equivalence argument in Murata, Chittick, and Tu's study, *The Sage Learning of Liu Zhi*, seems to rest primarily on a broad correspondence between Liu's writing and the ideas of Ibn 'Arabi on *tawhid* (oneness of God) and *tahqiq* (roughly, intrinsic spiritual knowledge). However, Murata and Chittick themselves seem to define the *tahqiq* approach to Islam in a way that leaves room for excluding any distinguishing factors of Islam:

> *The primary aim of those who focused on tahqiq was not to teach dogma or doctrine; nor was it to pass on the received learning or to instruct in proper morality and practice. Such scholars considered the formal aspects of the tradition, with its dogma and doctrines, less important than… the transformation of the soul and conformity with the Supreme Reality.*[4]

The concept of a Supreme Reality is, of course, by no means unique to Islam. Such thinking is found readily in Chinese Buddhism, and it also aligns with the Chinese conception of *tian* (天). However, Liu steps even closer to Chinese Buddhism when he expounds the Supreme (or Muhammadan) Reality in terms of the unity of all things, or of the identity of unity and multiplicity, ideas which are at least as close to the Chinese-developed notion of a universal Buddha-nature, for instance, as to *tawhid*. Furthermore, this conception of *tawhid* is by no means a universal one among Chinese scholars who studied Islam. Liu's contemporary Wang Daiyu (c. 1590 - c. 1658), who also features prominently in the Han Kitab, conceives of *tawhid* in terms of dogma. Tu Weiming writes that Wang "explains why followers of the Three Teachings… fail to perceive *tawhid* adequately or live up to its demands".[5] Therefore, this line of argument does not suffice to firmly establish Liu Zhi's thought as fundamentally and uniquely Islamic.

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Many of the other claimed examples of direct borrowing or adaptation can also be contested.[6] Lee, for example, claims the influence of Ibn 'Arabi in the category of the "perfect human being" or "Embodied One". However, even this category can be found in preceding Chinese discourse: multiple translators of the Platform Sutra of the Sixth Patriarch - a Buddhist scripture dating at least to the 9th century - find the term *zhiren* (直人) and render it Perfect Man.[7] Its associations with Taoism, furthermore, are extensively documented.

Accordingly, Murata and Chittick write that

> *most "Islamic" knowledge is by definition transmitted, since its specifically*
> *Islamic color comes by way of its conformity with the Koran and the Hadith… To*
> *say 'Muhammad is God's messenger' means to acknowledge that Muhammad was sent by God with a message, and that the message tells people what God wants from them. This knowledge is conveyed first of all in the Koran, and then in the Hadith, dogma, ritual, and rules. The only way to gain it is to receive it by transmission. You cannot discover it in your own heart.*[8]

If Islam "declares the importance of historical and transmitted knowledge", how can the inherent, non-transmitted component alone confer a primarily Islamic character? Murata and Chittick attempt to provide an accurate survey of the character of Islam at large while also attempting to fit in systems that are supposedly equivalent at root. However, not only do they ignore the crucial role of adherence to the transmitted forms, they even seem to be unable to convincingly establish an equivalence in broad principles between the Han Kitab and its Islamic influences and sources.

III. The *Root Classic* in Chinese and Arabic

My argument against the dynamic equivalence theory with respect to Liu Zhi is supported by a critical examination of the text studied by Murata and Chittick, the *Root Classic*, a summarizing appendix to Liu's *Nature and Principle in Islam*. Even allowing for some evidence of dynamic equivalence - which, as shown above, can at least be strongly contested - Liu's treatise is entirely and actively devoid of any references to the distinguishing features of Islam, such as an active Creator God and the Prophet Muhammad. Instead, Liu Zhi relies on concepts and terms embedded firmly in the Three Teachings. In itself this already serves to weaken the argument that Liu's work is Islamic in character, but it becomes especially clear when compared with the accompanying

[6] Much of what Murata et al. hold to be direct borrowing has to do with highly specific and technical cosmological schemes. A thorough analysis of those schemes would be outside the scope of this paper, but I attempt to show that the overall purport of Liu's work is unaffected.
[7] Philip Yampolsky and Chu Dongwei are two such translators.
[8] Murata et al., *The Sage Learning of Liu Zhi*, 22-23.

Arabic translation from the Chinese, *The Subtleties* (*al-Lata'if*), written by Nur al-Haqq.[9] Aside from the question of external forms and labels, however, a comparison of the two texts also reveals a great disparity in fundamental meaning - for Nur al-Haqq, the universe is created by God's hand, whereas Liu Zhi illustrates a passive evolution.

The weakness of an Islamic classification of Liu Zhi becomes clear from the very beginning of the Root Classic. At the beginning of the first chapter, where Nur al-Haqq includes the *basmala*, Liu omits it. The first line of the chapter is "Glory be to Him who was a Hidden Treasure!" in the Arabic, but "How pure is the Root Suchness!" for Liu. The line is thus stripped of devotional language and of any reference to God.[10] At the conclusion of this volume, Nur al-Haqq adds the following, which he apparently felt was missing from Liu's text: "And praise belongs to God, Lord of the worlds."

In the text itself, the dynamic equivalence hypothesis is first strained in lines 10-11. In Arabic, it is: "He brings to pass the Muhammadan Reality,/so, the First Engendered Being comes to be by the Command." Liu has: "The Real Principle flows and goes,/and the Mandate shows the original transformation." Several points of disparity can be observed here. Any active voice ("He brings") becomes passive ("flows and goes") in Liu's text. Where Nur al-Haqq makes explicit reference to the Muhammadan Reality, Liu refers to the Real Principle, favoring the Confucian term *li* (理, principle) over any invocation of the Prophet. Nur al-Haqq has God's Command bringing about Being. Liu uses Mandate (命, *ming*), which does not entail the existence of an active issuer. The Nur al-Haqq version has the overall character of a discrete event, whereas Liu's seems eternal and recurring.[11]

In line 13, the distinction between "soul and intellect" referred to by Murata and Chittick is rendered with the Confucian terms *xing* (nature) and *zhi* (wisdom).

In line 14, where Nur al-Haqq refers to "branch[ing] out", Liu has "This one reality has ten thousand differentiations." In addition to the obvious resemblance to Buddhist and Daoist thought - Benite observes that it is "borrowed from Daoist philosophical discourse" - the phrase itself is distinctly Neo-Confucian[12]. The Chinese is *yi shi wan fen* (一实万分), which appears in an 11th century work by Zhou Dunyi. Interestingly, it is Zhou who is credited with the development of *taiji* or Supreme Ultimate (太极), representing the undifferentiated being from which *yin* and *yang* emerge. The root meaning derives from long-established Neo-Confucian thought, not from any perceived concordance with Islam[13].

Starkly differentiating Liu's increasingly apparent passive formulation from the active, creator-focused Arabic back-translation is the continual appearance in the latter of the

[9] The Arabic name taken by Ma Lianyuan (1841-1895).
[10] Ibid., 102-103.
[11] Ibid.
[12] Zvi Aziz Ben-Dor Benite. "Sachiko Murata, *Chinese Gleams of Sufi Light*." *International Journal of Middle East Studies* 35 (2003): 344-346.
[13] Murata et al., *The Sage Learning of Liu Zhi*, 104-105.

word *Allah*. Where the agency of God is clearly outlined by Nur al-Haqq, Liu only has *(yuan)sheng* "emerged" or *shengyan* "came forth".

Another set of terms whose translation makes the idea of "equivalence" seem highly dubious is Sovereignty and Kingdom. Sovereignty first appears in line 15, where Liu Zhi has li, principle. In line 53, both terms appear, the former again as li and the latter as qi, vital energy. This is the first sign of a major concept for Liu which does seem to accord with the Sufi thinkers he takes as sources, namely, the differentiation between eternal Principles and their myriad worldly manifestations.

As an aside, the same connection to *taiji* and other Chinese categories is noted by Murata in her explanation of the Root Substance:

> *...Root Substance (*benti*) is used by various schools of Chinese thought to designate Ultimate Reality. In summarizing its significance, Chung-ying Cheng says that it designates the boundless source of creativity and transformation… and 'integrates and fuses heaven,* dao*,* taiji *[the Great Ultimate], and* wuji *[the Non-Ultimate].'*[14]

Following from the connection with *taiji*, *yin* and *yang* do emerge in the text, starting from line 20. The Arabic version refers to God in the active role, where again Liu Zhi represents an inexorable and organic progression with *yin* and *yang*.[15]

The contrast between terms with long-standing Islamic associations in the Arabic and those with strong Confucian meaning in the Chinese grows even more in the second chapter, whose title refers to "*created* things" (emphasis mine) in the Arabic only. In lines 5-6, Liu offers new glosses for Sovereignty and Kingdom, *xiantian* and *houtian*, both using the meaning-laden *tian*. In line 20, where the Arabic has *khatam*, Seal of the Prophets, the Chinese is *zhisheng*, or Utmost Sage.

Where Nur al-Haqq has faithfully used the Muslim terms for different classes of believers and nonbelievers, Liu uses different kinds of sage, or at least native terms that do not carry the Arabic meaning. In line 34, *'abid*, worshiper, is rendered *shanren*, "good person". In line 36, *'asin*, disobedient, is *yongchang*, "commoners". In the notes, Murata raises the possibility that Liu Zhi's classification of humans is based in the nine human levels of Nasafi, but Nasafi's classification is shown there to align only with the Nur al-Haqq version, not Liu's original, which replaces well-established Qur'anic terms such as *khatan*, *rasul*, *wali*, and *nabi*, with different kinds of *sheng*, sage.

Perhaps most decisive, however, is a single line in the third chapter. This chapter provides an account of the development of the "spiritually living" person; line 68 details the emergence of respect for the external forms of Islam. The Arabic uses the terms *ibadah* and *adab*. *Ibadah* refers to worship, but connotes obedience and submission, sharing a triliteral root with *ubudiyyah*, "slavery". In the Qur'an, *ibadah* is used in the

[14] Ibid., 199.
[15] Ibid., 104-105.

following verse: "And I did not create the jinn and mankind except to worship me" (Q51:56). *Ibadah* then not only carries the signification of submission to God (*Islam*) but also indicates that the very purpose of humans is to submit to God, the creator. *Adab* denotes manners or courtesy.

The Chinese terms employed by Liu Zhi are *li* and *jie* respectively. *Li* has already appeared as a gloss for entirely different Arabic terms, and is discussed again below. *Jie* appears frequently in the Analects of Confucius and refers to "regulations" pertaining to people of different ranks or stations in Confucian society. It also carries diverse meanings such as "moderation" and "fidelity", generally seeming to indicate a means of harmony with the principles (*li*) of nature. While in a very broad sense it invokes an inherited authority and perhaps a goal of union with nature, it does not carry any of the Qur'anic signification of *adab*, nor does Liu attempt to add any.

Li again appears as a gloss in line 50 of the fourth chapter, where it translates Shariah. But Shariah is not merely a metaphysical term; it refers to a specific system of moral regulation and jurisprudence based directly in the Qur'an and *hadith*. None of this is preserved or invoked by using the term *li*, which overwhelms any abstract similarity with its own rich Confucian meaning. It is already clear, then, that there is a wide disparity in meaning between the text as represented in Arabic Islamic language and the same text as represented in Chinese Neo-Confucian language.

The diagrams Liu provides to illustrate the worldview set out in the Root Classic further illustrate his metaphysical focus. Examining the diagrams corresponding to the first chapter, as numbered by Murata and Chittick, diagram 0.1 emphasizes the "undesignation of the earliest beginning". Diagram 0.2, a "sequence of the transformation of principles", begins with the impersonal progression of Substance Function Act, then proceeds to Mandate (again, 命). This provides support for the inference above that Liu Zhi does not consider the Mandate to issue from a creator. Diagram 0.3, another such sequence, begins with vital energy (气, *qi*), another distinctly non-theistic category. From there, *yin* and *yang* are introduced. Finally, I will note that the very structure of diagram 0.6 - the "circle of creation and transformation" - is significant in its departure from the Islamic world structure. The Qur'anic progression is linear: God creates all things, or, God conveys His word to the Prophets. Liu's diagram has no beginning and no center; as is clear from the text, things arise and fall of their own accord.[16] This may align closely enough with the thought of Ibn 'Arabi and his students, but once again the root meaning cannot be definitively classified as Islamic as opposed to belonging fundamentally to the Three Teachings.

One must conclude, then, the two accounts are entirely different in their character. Liu Zhi's account portrays the natural, unactivated progression of nature from the original undifferentiated Being, an entirely impersonal process. Nur al-Haqq refers to the active role of God as Creator, almost resembling Genesis. The two engage a similar progression

[16] Ibid., 158-171.

- since, of course, Nur al-Haqq is translating Liu - but the "dynamic meaning" is hardly equivalent.

IV. Liu Zhi's divergence in secondary literature

A survey of the secondary literature also finds broad support for at least some version of the thesis that Liu Zhi ultimately sinicizes Islamic beliefs and concepts.

I quote at length again from Murata to recapitulate the broad, metaphysical terms in which Liu's work must be described:

> *'Real One' knows in itself the principle of all manyness. This principle of manyness is called the 'Numerical One', because it gives rise to the multiplicity of*
> *the universe just as the number one gives rise to all the numbers. But the universe can only read the fullness of its possibilities through being brought back to the One from which it arose. This is the function of human beings, who, among all creatures, are uniquely qualified to be the 'Embodied One'.*[17]

As laid out above, it is the lack of engagement with the differentiating elements of praxis and dogma that weakens the Islamic classification of this work.

Frankel writes that "Liu Zhi downplayed the role of revelation, rather expounding theological concepts with frequent reference to natural law." Lee concurs: "The core teaching of the work is the multiplicity and unity of God… Liu Zhi also briefly mentioned the uniqueness of the prophet Muhammad." Schurich provides the orthodox contrast, writing that "[Muhammad's] importance stems from his relationship to the Qur'an", which has "absolute centrality in Islam."[18]

The issue of the treatment of Muhammad bears further investigation. In Murata's assessment, Liu Zhi holds Muhammad to have "a pre-creation metaphysical existence." Thus, Liu discarded the Qur'anic and early Islamic picture of Muhammad as distinctly human, even lacking divine qualities, in favor of a conception of Muhammad which is difficult to formally distinguish from that of God. Lee observes that Liu's treatment of Muhammad in his biographical work "came close to divinizing the prophet… Liu Zhi put the prophet… at the centre of human existence". Indeed, Wang Daiyu wrote of Muhammad that he encompassed "in unitary fashion all the realities and principles that give rise to the infinitely diverse universe. Thus the Muhammadan Reality is God". The statement cannot be made more clearly than this.

Liu's account of the Five Pillars similarly takes great liberties in reinterpreting the forms of Islamic belief, though a full survey of that treatise is outside the scope of this paper. "The goal of Muslims," he wrote, "is to recover the mandate and return to the Real. Return is the

[17] Lee, *Contextualization of Sufi Spirituality*, 91.
[18] Schurich, "Review of Murata".

end of the spiritual way." Here the Han Kitab teachings break from Islam not only in its emphasis or conception of history but in its adherence to the basic tenets of Islamic practice. Liu also wrote works addressing Islamic ritual and praxis, but, as Petersen observes, "All of these works demonstrated Liu's affinity for Neo-Confucian thought and his engagement with the three teachings of China (sanjiao 三教) - Daoism, Buddhism and Confucianism".[19]

Zvi Ben-Dor Benite's assessment is that Liu Zhi's work "has as its starting point a *filiation* in Islam but insists that Islam be viewed through the lenses of dominant Chinese cultural categories" (emphasis mine). Lee distills Benite's study into the thesis "Chineseness is as central as Muslimness." This is exactly synonymous with my contention that Liu is at least as close to the Three Teachings as to Islam, if not more.

Particularly interesting is an observation made by Leslie and Wassel in their examination of Liu Zhi's sources: "Most of the texts in Arabic are standard Sunni Hanafite texts of law and ritual." It cannot be argued, then, as Murata does in part, that the lack of distinctly Islamic characteristics in the Han Kitab results merely from its connection to Sufism; orthodox Hanafi texts are subject to the same reinterpretations. In other words, even Hanafi influence is unable to pull Liu further away from Chinese thought towards distinctly Islamic thought.[20]

From a purely theological angle, then, the Islam developed by Liu Zhi cannot be uniquely attributed to Islam at all. However, the argument for this break can be further strengthened by an account of his probable goals, or, at least, the historical context. Lee wrote that Liu needed to be able to "claim legitimacy for Islam in Chinese culture and orthodoxy in all other religions."[21] He was therefore forced, or at least inclined, to weaken the formal, distinguishing Islamic elements while integrating Chinese thought to the point of compromising the original Islamic character.

It is also worth noting that, while prominent Western scholars such as Murata and Lee have argued against viewing the Han Kitab as a sinicization of Islam, the majority of Chinese scholars also believe, in Lee's words, that "Hui Islam was sinicized by Liu Zhi's morals." Sha Zhongping, for instance, constructs a sophisticated view of Liu's reinterpretation of Islam by considering the concept of the Real One. Sha sets out a two-step transformation. First, Liu translates Allah as "Real Ruler", a "contextualization of naming". Second, Real Ruler becomes Real One, which, crucially, is a "transformation of content". Sha then points out the concordance between the Real One and the Neo-Confucian *li*. Reviewing this account, Lee admits, despite his support for the contextualization thesis: "The proof of sinicization of Chinese Islam is Liu Zhi's concept of Real One that takes over the Arabic divine name Allah."

While addressing the secondary literature in Chinese, one cannot overlook that there are also some Chinese scholars - whose opinions Lee admits are in the minority - who argue

[19] Kristian Petersen, "Understanding the Sources of the Sino-Islamic Intellectual Tradition", *Philosophy East and West* 61, no. 3 (2011): 546-559.
[20] Lee, *Contextualization of Sufi Spirituality*, 78-79.
[21] Ibid., 71.

that Liu Zhi did expound a uniquely Islamic philosophy. Lee gives as an example Yang Zhongdong, who argues that, despite the concordance of Liu's teachings with *li*, Liu "clearly had a specific goal of union with the divine being".[22] However, as observed, this concept of union is very broad and universal, especially in native Chinese spirituality. Even if Liu does not fall entirely in line with Neo-Confucianism, he is still not divergent enough to require an Islamic account of his ideas.

V. Conclusion

Thus, in order to accommodate Liu Zhi as a primarily Muslim thinker, the category of Islam must be expanded to the point of being entirely uninformative from a theological standpoint. By demonstrating that the dynamic equivalence hypothesis effectively prevents differentiating Islam and Neo-Confucianism, its ultimate inconsistency is revealed. Schurich, in his review of *The Vision of Islam*, praises Murata and Chittick for "show[ing] that Islam has a profoundly consistent and coherent vision of existence." This vision of existence is defined primarily by the Prophet Muhammad and the dogma and regulation laid down in the Qur'an and the Hadith. Though this tradition is developed further and broadened, as with Sufism and the writings of Ibn 'Arabi, these crucial elements of Islam are still entirely replaced with Neo-Confucian terms and concepts in Liu's writings. It seems that it is *only* in the preservation of some vaguely analogous forms, or even only in nominal self-identification, that Liu's work comes to be considered Islamic.

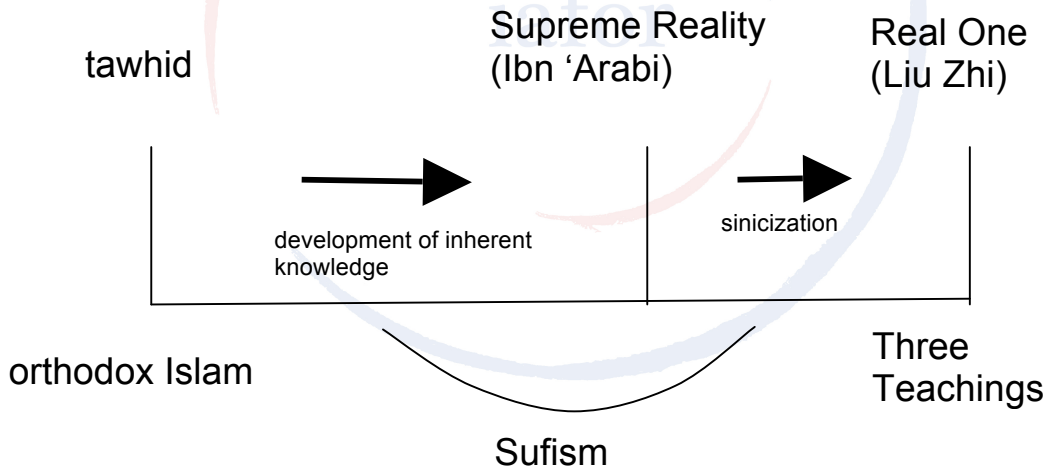

Fig. 1. A representation of the relationship between Liu Zhi's thought and Islam.

This approach downplays the emphasis on root similarities between highly disparate systems such as Islam and Neo-Confucianism, found in the work of Murata, Lee, and others, in order to recognize them as in fact separate. When the divine is conceived on a broad level, there are of course broad similarities. However, religion is at least as much concerned with adherence to external forms and rituals as it is with "inherent meaning". The extrinsic, culture-specific characteristics provide a system in which a believer takes

[22] Ibid., 76-77.

faith, to which a follower submits, and subsequently builds family and societal ties around, resulting in a unique subjective experience that cannot be reduced to principles. The state of scholarship on Liu Zhi thus constitutes an important but unrecognized flashpoint with respect to what religion actually is.

It should be made clear that this thesis is only being defended here with respect to Liu Zhi himself, who, though the most prominent Hui scholar, is not the only one. Petersen summarizes the orientation of the Han Kitab authors thus: "*The Sage Learning* demonstrates that Liu enthusiastically adopted the essence of Neo-Confucian thought… Wang utilized its symbolism but was often unsympathetic to its inherent meaning. Ma Dexin, on the other hand, explicitly maintained the Sino-Islamic tradition of his predecessors while simultaneously pushing for greater inclusion and understanding of Arabic writing and the Qur'an."[23] It is naturally understood that there is a mutual exchange between the global *ummah* and the Chinese Muslim community. I only argue that Liu does not engage the exchanged elements of Islam to enough of an extent to be considered adherent to it, at least uniquely.

As a further cautionary note, this argument should not be interpreted as an indictment of Chinese Islam. I have only attempted to show that the disparities between Liu Zhi and the rest of what is considered Islamic are so great as to finally break the category of Islam. It is, however, to be respected that Chinese who practice these teachings call themselves Muslims and consider Islam to be a part of their ethnic traditions. I certainly would not argue that their self-identification should be invalidated or called into question. It is only from a religious studies perspective that this distinction should be made, with the fact of Muslim identification being ascribed to Chinese historical factors rather than theological ones.

[23] Petersen, "Understanding the Sources of the Sino-Islamic Intellectual Tradition".

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