Consciousness of Training Body Part(s) by Showing a Picture of Various Exercises in Trunk Muscles*

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The aim of the present study was to investigate the consciousness among young people (n = 1000) of training body part(s) by showing participants a picture of trunk muscle exercises through a questionnaire-based survey. The participants were shown a picture of bent-knee sit-up (sit-up), back extension (back-EXT), and plank from elbows to toes (plank), and were asked which body part(s) they felt was being trained in each picture. As for the frequency of performing these exercises, only 3% and 8% of all the participants had never performed sit-up and plank exercises, respectively. On seeing the picture, 40-60% of the participants who had no experience doing a sit-up or back-EXT felt that these exercises were to train not only the agonist muscle but also the antagonist muscle. Approximately 40% of the participants who had no experience doing a plank exercise felt that it was not to train the epigastrium or hypogastrium area. Among the participants who experienced doing a plank exercise without a previous experience of strength training under professional supervision, more than half felt that plank exercise was appropriate to train not only the trunk but also the upper limb or lower leg. Furthermore, among the participants who had a previous experience of strength training under professional supervision, approximately 30% had such an opinion. Therefore, although the penetration rate of these trunk exercises are high, doing trunk exercises by referring to only a picture may result in the participants not properly understanding how the body part(s) should be trained during the exercise. Therefore, to enhance the benefits of trunk exercises, individuals (even those who had a previous experience of training under professional supervision) always need to be instructed through appropriate supervision on the correct technique and knowledge about the exercises.

Keywords: strength training, core, torso, exercise instructor

1. Introduction

A wide variety of trunk exercises are currently used for training and conditioning purposes, both in athletic programs and rehabilitation practice (Konrad et al., 2001). A survey on trunk exercises among university students revealed that individuals who exercise regularly frequently perform these exercises (Oshita et al., 2015b). However, various definitions of “trunk” (or torso) exist. For instance, the torso is described as running from the pelvis to the neck, and encompasses the entire chest and thorax region (Eaves, 2011). Another textbook states that the thorax and abdomen make up the trunk or
torso, and the axial skeleton consists of the trunk and head (Seikel et al., 2015). Although the trunk is described as being separate from the back or lumbar region depending on the textbook (Shiland, 2017), it can be defined as the part of the body excluding the head and appendicular. Furthermore, the term “core” is also widely known in the field of exercise training. The upper quadrant core includes the muscles in the rotators of the glenohumeral joint and scapula, and the lower quadrant core comprises the muscles in the trunk and hip (Donatelli, 2007). The discussion in this paper does not discriminate between the trunk and core, because debating the definition of trunk is not the purpose of this study. Therefore, the description of trunk in this paper includes “core”. The muscles between the pelvic bones and either the spinal column or rib cage mainly contribute to the movement of the trunk (i.e., large and small groups arranged anteriorly and posteriorly over the abdomen and back, respectively, and including the chest wall muscles) (Nelson and Kokkonen, 2014; Hoyos and Prendergast, 2014). Trunk (core) exercise refers to training designed to address these muscles or muscle actions (Stephenson and Swank, 2004).

Even though referred to as trunk exercises, some activities that mobilize the trunk muscles and appendicular muscles have been introduced in books on trunk exercises. These are dynamic exercises such as sit-ups, exercises involving maintaining a pose such as a front plank, and so on (National Strength & Conditioning Association, 2016). Therefore, despite being trunk exercises, increased appendicular muscle activity occurs, which differs according to the method by which the exercise is executed. Furthermore, individual differences in muscle activities during these exercises are substantial. For instance, during a sit-up, high levels of muscular activity of the rectus femoris and rectus abdominis are observed, and individual differences are substantial (Konrad et al., 2001). In addition, the amount of muscle activity differs according to the execution method of the exercise (Takai et al., 2005). Similarly, high levels of muscle activities of the rectus femoris and rectus abdominis are observed even in the front plank (Oshita et al., 2005), with these muscle activities differing according to the positioning of the supporting limbs (Schoenfeld et al., 2014). Therefore, Goodman (2004) pointed out that little has been conveyed to athletes on what qualifies as the trunk (core) and how to target muscles that may be beyond the scope of the regions commonly referred to. Moreover, a survey of university students found that trunk exercises were frequently performed regardless of an understanding of the trunk region (Oshita et al., 2015a). Thus, possibly, many people perform trunk exercises without being aware of the actual area being trained.

From a sports performance viewpoint, excessive focus on the agonist muscles during movement is disadvantageous. For example, focusing on the contraction of the biceps brachii when performing an arm curl increases their activity. However, if focusing on the movement of the bar, biceps brachii activity decreases and the velocity of the curl movement increases, improving the efficacy of the movement (Vance et al., 2004). Here, understanding the agonist muscle group is necessary when wanting to increase the effectiveness of strength training. For instance, exercises can elicit even greater effects by following various training principles such as that of awareness. Training effects reportedly increase by focusing on the contracting agonist muscle group and contraction timing (Kouda, 1994). In an experiment on the aforementioned arm curl (Vance et al., 2004), biceps brachii activity during the exercise reportedly increased by focusing on the biceps brachii contraction. Furthermore, an understanding of the agonist muscles is important when considering the arrangement of exercises. For example, it has been suggested that the “supersetting method”, which involves performing antagonist area exercises following agonist area exercises (Clayton et al., 2015), is effective for muscular hypertrophy (Schoenfeld, 2011). Based on these previous studies, understanding the agonist muscles of an exercise and choosing suitable exercises is important in obtaining better training effects.

However, as noted, the trunk and other muscles are mobilized in some trunk exercises. This indicates the possibility that many individuals do not understand which muscles are being trained during these trunk exercises. A survey regarding the back squat found that individuals without previous exercise experience under the instruction of a professional coach or instructor do not understand which muscles are being trained in the exercise (Oshita et al., 2015b and 2016). In addition, compared to dynamic exercises such as sit-ups, in static exercises such as a front plank, it is difficult to understand the agonist
muscles without an accompanying movement. Thus, this indicates that understanding of the agonist muscle could differ depending on the kind of trunk exercise. Therefore, the present study investigates the differences in understanding of the area to be trained through various types of trunk exercises according to the experience of receiving exercise instruction and status of performing these exercises.

2. Method

2.1. Participants

The participants were 1041 men and women (762 male, 279 female, 19±1 year) from national universities, private universities, and national colleges of technology (where a fourth-year college student is the equivalent of a first-year university student). Of these, the responses of 1000 (731 male, 269 female) participants, less 41 unreliable responses, were analyzed.

A questionnaire-based survey was conducted from January to December 2016 using the collective survey method. Participants were verbally informed beforehand that the questionnaire answers would be anonymous and used only for research purposes. They were also informed that while the obtained data would be published after being statistically processed such that individuals could not be personally identified, some diagrams might be published as they are. The survey was conducted only if these terms were accepted. This study was approved by the ethics committee of Kyushu Kyoritsu University (No. 2014-06).

2.2. Questionnaire survey

In this study, the sit-up, a well known abdominal dynamic exercise (Escamilla et al., 2006; Norris, 1993); back extension as an antagonist area exercise; and front plank as a static exercise were the trunk exercises that formed the object of the survey. Since the focus was on participants’ subjective area trained through these exercises, the following items were analyzed in the questionnaire survey.

Regarding the frequency of performing each exercise, participants were shown photographs of a sit-up in the NSCA’s textbook (Earle and Baechle, 2010, p. 367), a back extension in JATI’s textbook (Aruga, 2009, p. 139), and a front plank in a research article by Oshita and colleagues (2005, p. 1283). (Schematic diagrams are shown in Figures 1, 3, and 5. The questionnaire contained the photos from each work mentioned above.) For each exercise, the question was as follows: “Have you performed the exercise as shown in the photo?” Participants answered on a five-point scale: “performing almost daily”, “performing several times a week”, “performing several times a month”, “I have performed the exercise at least once”, and “I have never performed the exercise”.

Information on the subjective area trained through the exercise was gathered using the following question: “Which body area do you think is being trained through the exercise in the photograph?” The selection options were shown on a diagram of a body divided on the frontal plane, and included the neck, chest, epigastrium, hypogastrium, shoulders, upper arms, forearms, hands, thighs, lower legs, feet, back, lumber, and hips. Furthermore, multiple responses were permitted (a response example is shown in Figure 7).

Although this study investigated the sit-up, back extension, and plank, participants were asked about their previous experience of receiving professional strength training instruction regardless of these trunk exercises. Information was gathered on a two-point scale of “yes/no” in answer to the question: “Have you ever had strength training instruction?” Those responding “No, I have not” were designated as cases where strength training was engaged in without much care or the participant performed the exercise by looking at instruction books or watching videos. Those who responded “Yes, I have” were asked whether they were instructed by a professional instructor (including sports coach) or not (friends and colleagues). Given the high possibility that qualifications and titles that guarantee instructor knowledge and coaching skills are not generally well known, judgment of whether an instructor was professionally qualified was left to the participant’s discretion.

2.3. Data analysis

To aggregate the results of the questionnaire survey, the frequency of performing each exercise was designated as a categorical variable, and a chi-squared goodness of fit test was performed. Follow-
ing this, groups with no experience of performing each exercise (NO-EXP group) and an experienced group were formed based on participants’ responses regarding frequency of performing each exercise. Following this, based on responses for experience of receiving instruction in strength training, the experienced group was delineated as those who had received it from a professional instructor or sports coach (INST group), and those who did not or who were instructed by a non-professional (NO-INST group). Moreover, the INST and NO-INST groups were further divided into those performing each exercise regularly (those who indicated performing each exercise more than several times per month) (INST + H-freq and NO-INST + H-freq groups), and those who seldom performed the exercise (indicated that they had performed each exercise at least once) (INST + L-freq and NO-INST + L-freq groups).

For the subjective area trained by each exercise, the absence or presence of awareness of the body part being trained were designated as categorical variables, and the differences between the NO-EXP, NO-INST, and INST groups were compared in a chi-square test. Then, a residual analysis was conducted of the body parts for which a significant difference was observed.

Furthermore, responses regarding the subjective area trained were categorized as indicated in Table 1 as follows: (1) participants who indicated only the body parts reported as an agonist muscle and observed higher muscle activity in each exercise and surrounding areas (Aruga, 2009; Clayton et al., 2015; Contreras, 2013; Earle and Baechle, 2010; Ekstrom et al., 2007; Imai et al., 2010; Oshita et al., 2005). (Muscle activity is detailed in the “discussion” section.) For example, here, a sit-up targets the epigastrium, hypogastrium, thigh (anterior), and neck (anterior); a back extension the neck (posterior), back, lumber, buttock, and thigh (posterior); and a front plank the shoulder, chest, epigastrium, and thigh (anterior). (2) In addition to the parts in (1), participants who also indicated the antagonist area. Here, a sit-up targets the back, lumber, buttock, and thighs (posterior); a back extension the chest, epigastrium, hypogastrium, and thighs (anterior); and a front plank the back, lumber, buttock, and thigh (posterior). (3) In addition to the parts in (2), participants who indicated any other areas. (4) Participants who did not answer by indicating the parts specified in (1). Regarding these four classifications of the responses for each exercise, the differences between the NO-EXP, NO-INST + L-freq, NO-INST + H-freq, INST + L-freq, and INST + H-freq groups were compared by performing a chi-square test. A residual analysis was conducted of exercises for which a significant difference was observed.

Using statistical analysis software (J-STAT version 12.5 and js-STAR version 2.0.6), the established level of statistical significance was less than 5%. We further calculated the $V$ values using Cramer’s method, and established the effect size as negligible for $V \leq 0.1$, weak for $0.1 < V \leq 0.2$, moderate for $0.2 < V \leq 0.4$, relatively strong for $0.4 < V \leq 0.6$, strong for $0.6 < V \leq 0.8$, and very strong for $0.8 < V$.

### 3. Results

In total, 339 participants had experience of receiving professional instruction, while 601 did not. Regarding the frequency of performing each exercise, 150 participants performed sit-ups almost

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**Table 1** Classification of responses regarding which body parts were considered to be trained when performing each exercise.

|                | Sit-up                          | Back extension                      | Front plank                        |
|----------------|---------------------------------|------------------------------------|-----------------------------------|
| ①             | Agonist area + around it        | Neck (Posterior), Back, Lumber, Buttock, Thigh (Posterior) | Shoulder, Chest, Epigastrium, Hypogastrium, Thigh (Anterior) |
| ②             | ① + Antagonist area            | ① + Back, Lumber, Buttock, Thigh (Posterior) | ① + Back, Lumber, Buttock, Thigh (Posterior) |
| ③             |                                 |                                    | ① + Another area                  |
| ④             |                                 |                                    | Did not answer ①                 |
Figure 1 provides the aggregated results for the association between the experience of receiving instruction and subjective areas trained when doing a sit-up. In all three groups, most participants perceived the epigastric and hypogastric (approximately 90% and 80%) as the areas trained. Although the percentage of participants in the NO-EXP and NO-INST groups who indicated that the lumbar (41% and 29%) and buttock (26% and 14%) were the areas trained was significantly higher than that of the INST group, the effect sizes were small. After classifying the body parts indicated in Table 1 (Fig. 2), the highest percentage of participants in all groups reported the agonist area as the subjective area trained. However, the ratio was significantly higher for the INST + H-freq group (81.5%) than the other two groups. Furthermore, the percentage of participants who indicated areas other than the agonist area as the subjective area trained was significantly higher in the NO-INST + L-freq and NO-EXP groups. The gender ratio (male: female) of all participants was 73.1% (n = 731): 26.9% (n = 269). Although the gender ratio of the NO-EXP group was biased toward males (92.6% (25): 7.4% (2)), the ratio in other groups was similar to that for the total participants (70.0-75.4%: 24.6-30.0%). These results suggest that most participants recognized that the abdominal area (epigastric and hypogastric) was being trained in a sit-up, regardless of having experience in receiving professional instruction. However, approximately half the participants who performed few sit-ups without experience of receiving professional instruction or those who had never performed one recognized that areas other than abdominal areas were also being trained.

Figure 3 provides the aggregated results for the association between the experience of receiving instruction and subjective areas trained in a back extension. In all three groups, most participants perceived the lumbar and back (approximately 90% and 70%) as the areas trained. The percentage of participants in the NO-EXP group who indicated the chest, epigastric and hypogastric (22-44%) as the areas trained was significantly higher than that of the INST group.
in other groups, and these effect sizes were moderate. Although the neck (anterior), shoulder (anterior), upper arm, forearm, hand, thigh (anterior), lower leg (anterior), and foot (anterior) were infrequently indicated, significant differences between groups were observed. However, these effect sizes were small. As a result of classifying the indicated body parts in Table 1 (Fig. 4), the highest percentage of participants in all groups indicated the agonist area as the subjective area trained. However, the ratios were significantly higher in the INST + H-freq group (76.3%), INST + L-freq group (66.5%), and NO-INsT + H-freq group (66.4%) than in other groups. Furthermore, the percentage
Figure 4  Classification of body parts indicated as the areas trained by frequency of performing the exercise and experience level of participants (back extension)  

(△ and ▼; significantly (P < 0.05) higher and lower (residual analysis))

Figure 5  Percentage of participants who indicated these as the areas trained when shown a picture of a front plank (Body parts enclosed by a square are indicated as being trained when performing a front plank)  

*; P < 0.05 (chi-square test), †; Small-sized effect (Cramer’s V = 0.10-0.20),  
△ and ▼; significantly (P < 0.05) higher and lower (residual analysis)

of participants who reported areas other than the agonist area (include antagonist area) as the subjective area trained was significantly higher in the NO-INST + L-freq and NO-EXP groups. The gender ratio (male: female) of each group (70.3-78.4%: 21.6-29.7%) was similar to the total participant ratio. These results suggest that most participants recognized that the back and/or lumber are being trained in a back extension, regardless of the experience of receiving professional instruction. However, more than half the participants who performed few back extensions without experience in receiving professional instruction or who never performed one recognized that areas other than the lumber or back
Figure 6 Classification of body parts indicated as the areas trained by frequency of performing the exercise and experience level of participants (front-plank)

\(\triangle\) and \(\nabla\); significantly (\(P < 0.05\)) higher and lower (residual analysis)

Figure 7 Example of responses regarding the areas trained when shown a picture of each exercise

1. Experience of receiving professional strength training instruction
2. Frequency of performing each exercise

were also being trained.

Figure 5 provides the aggregated results for the association between the experience of receiving instruction and the subjective areas trained when performing a front plank. Although most participants in all groups perceived the epigastric and hypogastric as the areas trained, a significantly lower percentage of participants who indicated these areas were in the NO-EXP group (approximately 60%) compared to the other groups. Furthermore, the percentage of participants in the INST group who indicated the epigastric (approximately 90%) area
as the one trained was significantly higher than in other groups. Although the percentage of participants in the NO-EXP and NO-INST groups who indicated the upper arm, foot (anterior), and lower leg as the areas trained were significantly higher than that in the INST group, these effect sizes were small. As a result of classifying the indicated body parts in Table 1 (Figure 6), the percentage of participants who reported the agonist area as the subjective area trained was significantly lower in the NO-EXP and NO-INST + L-freq groups. The percentage of participants who indicated both the agonist and antagonist areas was significantly higher in the INST + H-freq group. Furthermore, the percentage of participants who did not indicate the agonist area was significantly lower in the INST + H-freq group and higher in the NO-EXP group. The gender ratio (male: female) of each group (71.0-77.4%: 22.6-29.0%) was similar to the total participant ratio. These results suggest that approximately half the participants who have never performed a front plank did not recognize that the epigastric or hypogastric areas are being trained when performing a front plank, and many participants who had received professional instruction recognize that both the agonist and antagonist areas are being trained.

A sample of these responses is provided in Figure 7.

4. Discussion

The present study investigated awareness of the body areas trained by showing participants a picture of trunk muscle exercises. On seeing the picture of a sit-up or back extension, most participants recognized that the agonist area was being trained, regardless of whether they had experience of receiving professional instruction in strength training. However, approximately half the participants who had never performed these exercises or who had no experience of receiving professional instruction recognized that both the agonist and antagonist areas were being trained. For a front plank, approximately half the participants who had never performed one felt it did not train the epigastrium or hypogastrium areas. However, many participants with experience of professional instruction realized that both the agonist and antagonist areas were being trained.

A sit-up is considered an exercise that primarily works the rectus abdominis (Earle and Baechle, 2010) or rectus abdominis and rectus femoris (Aruga, 2009; Contreras, 2013). A higher level of muscular activity is generally observed in these muscles (Escamilla et al., 2006; Konrad et al., 2001; Takai et al., 2005). In the present study, most participants in all groups indicated that a sit-up trains the epigastrum (approximately 90%) and hypogastrium (approximately 80%) (Figure 1). Furthermore, the level of muscular activity in the back and lumbar areas such as the erector spinae and glutaeus maximus is extremely low (Escamilla et al., 2006; Konrad et al., 2001; Takai et al., 2005). However, more than 40% of those in the NO-EXP and NO-INST + L-freq groups indicated these areas as the subjective areas trained (Figure 2). This was also the case for a back extension. Muscular activity during a back extension is higher in the erector spinae and trapezius (middle part), and comparatively higher in the glutaeus maximus (Konrad et al., 2001). Even in this study, most participants indicated the lumber (approximately 90%) and back (approximately 70%) as the subjective areas trained when performing a back extension (Figure 3). In contrast, despite that muscular activities are extremely low in the rectus abdominis and rectus femoris (Konrad et al., 2001), approximately 50% and 60% of those in the NO-INST + L-freq and NO-EXP groups also selected these abdominal areas as the subjective ones trained (Figure 4).

While a sit-up is generally promoted as an abdominal exercise (Escamilla et al., 2006; Norris, 1993), those who have never performed one and had no experience receiving professional instruction might not adequately understand the area trained in the exercise. Consequently, the percentage of participants who indicated the chest and/or abdominal area as the one trained when performing a back extension was significantly lower in the INST groups, and these effect sizes were moderate (Figure 3). While exercise textbooks or videos detail the body areas targeted by the exercise alongside how to perform it, in the absence of any points to note, most do not mention other areas. However, the results of this study indicate that most participants in the NO-EXP and NO-INST groups report feeling that both the agonist and antagonist areas are being trained when performing a sit-up and back extension. Therefore, these exercises should be performed with
a professional instructor by those who have never performed the exercise or never received professional instruction. On the other hand, although the number of participants who indicated the antagonist area as being trained in a sit-up significantly differed among the NO-EXP, NO-INST, and INST groups, the effect size was small (Figure 1). Therefore, this difference is significant, although only slightly. Regarding considering the frequency of performing the exercise (Figure 2), the percentage of participants in the INST and NO-INST groups who indicated only the agonist area as the one trained was significantly higher in the H-freq group than in the L-freq group. Moreover, in the case of frequently performing the exercise even when no professional instruction had been received (i.e., NO-INST + H-freq group), the percentage of participants who indicated only the agonist area was similar to that for the INST + L-freq group. When doing these types of dynamic exercises, participants perceive the body parts that move (contract) when performing the exercise as the areas trained. Thus, by performing the exercise regularly in addition to the experience of receiving professional instruction, it is possible to increase the level of understanding of the agonist area engaged in the exercise.

Because activity of approximately 30-60% MVC in abdominal muscles such as the rectus abdominis (Ekstrom et al., 2007; Imai et al., 2010; Oshita et al., 2005; Schoenfeld et al., 2014), and 67% MVC in the rectus femoris (Oshita et al., 2005) has been observed during a front plank, the frontal plane of the trunk (Clayton et al., 2015) or rectus abdominis and quadriceps femoris (Clayton et al., 2015; Contreras, 2013) are considered the areas primarily trained. Muscle activities in the erector spinae, gluteus maximus, hamstrings, multifidus spinae, and longissimus thoracis during a front plank are reportedly lower than 10% MVC (Imai et al., 2010; Ekstrom et al., 2007). For middle-aged individuals, often considered to have less muscle strength than younger people, muscle activities in the spinal erectors and biceps femoris during a front plank are 11.9% and 9.9% MVC (Oshita et al., 2005). However, the percentage of participants who indicated the abdominal areas as those trained when performing a front plank was significantly lower in the NO-EXP group. Approximately 40% of the participants in the group did not indicate the epigastrium or hypogastrium as the area trained (Figure 5). For static exercises such as a front plank, participants might find it difficult to pinpoint the areas trained because of the lack of movement during an exercise (i.e., maintenance of a certain posture). This could be why a lower percentage of participants indicated the agonist area as that trained when performing a front plank compared to a sit-up or back extension. In addition, more than 50% of participants in the NO-EXP and NO-INST + L-freq groups indicated the appendicular parts (excluding rectus femoris) as the areas trained in a front plank. Moreover, around 20% of participants in the NO-EXP group did not indicate the agonist area, but other body parts (Figure 6) as the areas trained. As shown by the sample response (Figure 7), some participants indicated only the feet and arms as the areas trained by a front plank, possibly because of the posture taken to sustain the body using the toes and upper limbs.

However, even in the INST + H-freq group, approximately 50% of participants indicated that the antagonist area was trained when performing a front plank (Figure 6). Only slight muscle activity is observed in the lumbar and gluteal regions during a front plank (Ekstrom et al., 2007; Imai et al., 2010; Oshita et al., 2005), and the activity of the erector spine does not significantly change when altering trunk posture by rounding the back (Schoenfeld et al., 2014). However, awareness of the muscles in the lumb or back is important to avoid excessive flexion or extension of the trunk (i.e., to maintain a suitable posture) during a front plank. Therefore, some participants in the INST + H-freq group might indicated the antagonist area. However, investigating young people’s understanding of the “trunk” showed that it is considered to include the “abdominal or back muscles”, and brings to mind “balance” and “stabilization training” such as when doing a front plank (Oshita et al., 2015a). As such, because some participants understand that maintaining the posture in a front plank can train the entire trunk including the abdominal and lumb back areas, the antagonist area is often indicated as the one trained when performing this exercise. However, because this discussion of the present results is “guesswork”, further research is necessary to determine the detail of responses. Even in the INST + H-freq group, approximately 30% of participants indicated that the appendicular areas (excluding the rectus femoris) were being trained.
when performing a front plank (Figure 6). For the abdomen, which is an agonist area when doing a front plank, the percentage of responses significantly differed between the NO-EXP, NO-INSTM, and INST groups; however, these effect sizes were small (Figure 5). This suggests that the differences regarding understanding the agonist area between groups are slight. Consequently, regardless of the experience of receiving exercise instruction, the results indicate that the agonist area is less understood for the front plank than for the sit-up and back extension. Therefore, it is recommended that as the experience of receiving professional instruction is not sufficient to understand the agonist area in static trunk exercises such as the front plank, these exercises should always be performed under professional instruction.

In terms of the frequency of performing an exercise, the penetration rate for sit-ups and front plank was high, because fewer than 9% of participants had never performed these exercises. However, 46% of participants perform sit-ups regularly even without the experience of receiving professional instruction (i.e., NO-INSTM + H-freq group). This rate was 43% for the front plank. Performing these exercises does not require special equipment or a large space, and they can easily be done through imitation. As such, the necessity of professional instruction is possibly not realized. Furthermore, even in the INST + H-freq group, some participants indicated the agonist and other areas as those being trained. Specifically, for a front plank, approximately 30% of participants in the INST + H-freq group indicated the appendicular as the area trained. In the present study, participants made judgments regarding the specialist nature of the instructor. As a result, because the INST group may include participants who had experience of receiving instruction in strength training from an instructor who was not a professional, the instruction may not have been appropriate. Moreover, the INST group may also include cases in which instruction was received for sit-ups, but not for plank exercises. These factors may have influenced the results of this study and should be considered in future research. The results of this research indicate a high penetration rate for trunk exercises, but indicate that the agonist area is not necessarily accurately understood, thus highlighting the necessity of an appropriate instructor when performing these activities.

Trunk exercises can potentially contribute to enhancing sports performance or reducing the risk of injury (McGill, 2010; Goodman, 2004). It is however debated whether trunk exercises effectively enhance the sports performance of athletes, who have established physical fitness and no reduced trunk muscle function, and thus whether they are beneficial and required for this group (Chui, 2007). Exercises should be selected based on understanding these issues. Therefore, it is recommended that not only exercise beginners and those with limited experience, but also those with experience of receiving exercise instruction should perform trunk exercises under the supervision of a professional instructor.

5. Summary

The present study investigated the awareness of the body part(s) trained by showing participants a picture of trunk muscle exercises. The penetration rate of sit-ups and front plank is high, because fewer than 9% of participants have never performed these exercises. On seeing the picture of a sit-up or back extension, most participants recognized the agonist area being trained by each exercise, regardless of their experience of receiving professional strength training instruction. However, approximately half of the participants who had never performed these exercises or who had no experience of receiving professional instruction recognized that the agonist and other areas were being trained. For a front plank, approximately half the participants who had never performed one felt that the epigastrium or hypogastrium areas were not being trained. Furthermore, more than half of the participants who have experience performing the front plank, but who did not receive instruction felt that the trunk and appendicular area were being trained. However, even among participants who had experience receiving professional instruction, approximately 30% indicated the appendicular area as that trained when performing a front plank. These results suggest that while the penetration rate of trunk exercises is high, performing them by referring to only a picture may result in participants not properly understanding which body part(s) should be trained during the exercise. Specifically, a lack of awareness of the agonist area in trunk exercises was greater for static trunk exercises such as the front plank than for dynamic ones such as a sit-up.
Therefore, it is recommended that not only beginners and those with limited exercise experience, but also those who have received exercise instruction should perform trunk exercises under the supervision of a professional instructor.

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Main Works:
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Membership in Learned Societies:
• Japan Society of Physiological Anthropology
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