運動パフォーマンスと認知機能の向上を研究　•Research on the improvement of exercise performance and cognitive function

健康の維持・増進、「体操×マウスリンス」という最適解

国際的課題の「運動不足」に運動生理学で挑む

Maintaining and improving health - “Exercise x Carbohydrate Mouth Rinse” as the optimal solution

Using exercise physiology to take on the international issue of “a lack of exercise”

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—— Professor *Tsuyoshi Wadazumi*

「堺コッカラ体操」をご存じだろうか。親しみやすいネーミングの通り、誰もが楽しく参加できるもので、開発したのは、人間健康学部の弘原海剛教授。堺市からの依頼で2014年に作られ、動画配信などで人気を得たオリジナル体操だ。ホールで行われるイベントも定着している。さらには弘原海教授の専門分野との相乗効果によって、前代未聞の領域へと進化を遂げ、海外への波及を目指す。

Have you heard of the “Sakai Co-kara Exercises”? As the friendly naming indicates, these are exercises that anybody can take part in and enjoy. They were developed by Professor Tsuyoshi Wadazumi of the Faculty of Health and Well-being. They are original exercises that were created in 2014 at the request of the city of Sakai and became popular through video streaming and other channels. Events held in halls are also becoming established. Furthermore, by using the synergy with Professor Wadazumi’s area of expertise, the research has advanced into an unprecedented field and there are aims to spread it overseas.

●堺コッカラ体操

Sakai Co-kara Exercises

■座った状態でもできる楽しい体操

——先生が開発した「堺コッカラ体操」について教えてください。

この体操は、関西大学と堺市の地域連携事業から生まれました。「高齢者向けの介護予防、認知症予防にもつながるオリジナル体操を作ってほしい」というオーダーでしたが、専門が運動生理学であり、当時体操実技についての見識はそこまでありませんでした（苦笑）。ただ義務感に駆られ、データや文献を集めるところから始めました。

体操のベースは、ブロックエクササイズ。手拍子、手で膝を叩く、手で机を叩くなどといった一つひとつの動き＝ブロックを組み合わせていく体操の形式です。音楽に合わせて座った状態でも行えるため高齢者にでもできて、何より楽しいのでぴったりだと考えました。

——体操の効果は、どのように実証していったのですか。

まず、体操がもたらす運動の強度と脳血流量を測定しました。すると、この体操の運動強度は2～3METs（メッツ）で、ゆっくりした歩行に相当。無理なく行えます。でも脳の活性化はジョギング運動時と同程度だと分かりました。

認知機能向上の検証には、TMT（トレイル・メイキング・テスト：数字や文字を、いかに指示通りに素早く選択できるか）やST（ストループテスト：色名読み取り課題と、色名と色の不一致課題）という検査方法を用いました。測定してみると、被験者の認知機能が、体操をした後に向上し、脳血流量の増加も顕著だったことから、堺コッカラ体操の効果が明らかになりました。

■エビデンスを増やし、SNSでの海外普及を目指す

——堺コッカラ体操には、さまざまなバリエーションが生まれていますね。

どんな音楽にも合わせられる体操で、見ても作っても楽しいというのが特長。飽きが来ないので続けられるんですね。

「堺コッカラ体操」の普及活動を進めていた頃、全国のご当地体操を調べたことがありました。気付いたことは、筋肉や関節に働き掛ける体操はあっても、認知機能に特化した体操は少ないということ。普及させる価値を感じました。そして現在は、海外にも需要があると考えています。

——海外ニーズですか。

2022年に関西大学の制度を使ってフランスに留学したのですが、現地には、高齢者向けの体操教室やアクティビティが、あまり無いんですね。高齢者コミュニティの方に、ブロックエクササイズを教えると、ぜひ広めたいと言ってくれたんです。最近ではテレワークの普及や子どもたちのゲーム人気もあり、座りっ放しの人の運動不足が世界的な課題になっています。体操の普及がそうした課題解決につながると考えています。

——どのように普及させていく予定ですか。

SNSの活用です。現在、学生と一緒に体操動画を作成してYouTubeにアップしていますが、英語や韓国語バージョンも作ってさまざまなSNS媒体を活用し世界へ向けて配信しようと計画をしています。

▲堺市内の各所で体操教室を実施

Exercise classes are held at various locations in Sakai City

■Fun exercises that can even be done while sitting

—— Please tell us about the “Sakai Co-kara Exercises” you developed.

The exercises were born out of a regional collaboration project between Kansai University and Sakai City. My order was to “create original exercises for elderly people that will help prevent the need for care and help prevent dementia.” However, my specialty was exercise physiology and I didn’t have much insight into practical exercises at that time. Nevertheless, I felt a sense of duty to create something and started by collecting data and literature.

The base of the exercises is block exercises. This is a form of exercise which combines a series of movements (= blocks), such as clapping, tapping a knee with a hand, and tapping a desk with a hand. The exercises can be performed to music and while sitting, so they are also possible for elderly people, and above all, they are fun, so I thought they were perfect.

—— How did you verify the effect of the exercises?

First, we measured the intensity of the exercise and the cerebral blood flow caused by the exercises. The results showed that the intensity of the exercise was 2 to 3 METs, which is equivalent to walking slowly. They can be performed without excessive effort. However, we found that the activation of the brain was about the same as during jogging.

To verify improvement in cognitive function, we used testing methods called TMT (Trail Making Test: Test to see how quickly the subject can select numbers and letters as instructed) and ST (Stroop Test: Color name reading tasks and tests where the color name and color do not match). When we took measurements, we saw that the cognitive function of the participants improved after the exercises, and also that there was a noticeable increase in cerebral blood flow, so this clarified the effectiveness of the Sakai Co-kara exercises.

■Increase the amount of evidence and aim to spread the exercises overseas via SNS

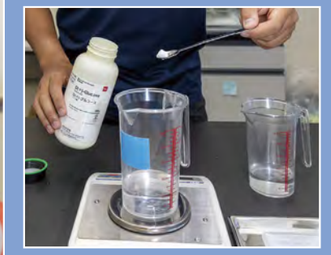
—— There have been many variations of the Sakai Co-kara exercises created.

These are exercises that can be matched to any music, so one feature is that they are fun to watch and also fun to create. You can continue doing them because you don’t get bored.

When I was working to popularize the Sakai Co-kara exercises, I spent time investigating the local exercise routines around the country. What I noticed is that while there are exercises that work on the muscles and joints, there are few that focus specifically on cognitive function. I felt that there was value in spreading the Co-kara exercises. And now I think that there is also demand for them overseas.

●炭水化物マウスリンス

carbohydrate mouth rinse



▲「炭水化物マウスリンス」の準備作業

Preparation work for carbohydrate mouth rinse

◀炭水化物を含む液体を口内にスプレーして握力の変化を測定

Spraying a liquid containing carbohydrates into the mouth and measuring changes in grip strength

自転車で負荷運動を行い有酸素性能力を測る装置

A device that measures aerobic capacity by performing load exercise on a bicycle

■大阪マラソンでスプレーの実効性を測定

――一方で先生は、「炭水化物マウスリンス」研究の第一人者でもありますね。

体操よりも、こちらが専門です。炭水化物マウスリンスとは、炭水化物を含んだ液体を口に含んで吐き出し、体内にエネルギー源を入れなくとも運動パフォーマンスの向上を図ろうとするものです。マラソンなど長時間に及ぶ競技では、どうしてもエネルギーが減少し、パフォーマンスが低下します。そのためレース前やレース中の炭水化物補給は不可欠なのですが、物を胃や腸に入れてしまうと、身体に負担がかかります。そこで、飲み込まずに吐き出すマウスリンスという方式が考案されました。

そもそも私は、効果的なスポーツドリンクの開発を目指していたのですが、その過程でマウスリンスに出合い、本格的に研究を始めました。

――どのように研究を進めてきたのでしょうか。

着目したのはマウスリンスの方法です。従来の「吐き出す」方法は衛生上の問題があります。しかし、スプレーを用いて噴霧すれば、それらを解決できると考えました。

共同研究者や学生と協力して、従来からの液体を口に含む方法とスプレー方式との効果に関する比較実験を繰り返し行い、実効性を検証。実験室では被験者に自転車で負荷運動を行ってもらいフルマラソンの35Kmの壁と呼ばれる身体のエネルギー枯渇状態を再現し、スプレー前後での血糖値等の変化及び運動パフォーマンスの結果を見極めました。また、私自身、大阪マラソンにも出場し、要所で採血をして血糖値を計り、35Kmの時点でスプレーを実施しました。実際に走ってみて、マラソンの過酷さとスプレーの効果を体感しました(笑)。いずれの実験でも、液体を口に含む方法とスプレー方式の効果に差がないことが立証でき、2022年に博士課程の学生が発表した成果論文は、研究者から驚きをもって迎えられました。

ちなみに現在は大手食品会社と協同でタブレットタイプを開発研究中。小さな固形にすることで、時間的にも物理的にもスムーズに摂取できると考えています。

■手が震えるほどの感動を覚えた相乗効果への期待

――今後、体操とマウスリンスの研究はどのように進んでいくのでしょうか。

この2つはある事象において相乗効果があると考え、研究を進めています。それは、認知機能への影響です。体操だけでなく、炭水化物もまた口に含むことで、脳に刺激を与えるということが分かっています。体操同様に、DLPFC(背外側前頭前野)という認知機能をつかさどる脳の部位を活性化させるんですね。この事実を、堺コッカラ体操を作り始めた頃に読んだ文献で見付けた時は「マウスリンスと同じじゃないか」と、感動で手が震えました。これまでに行った実験でも、エクササイズだけを行うよりも、合間にスプレーでマウスリンスを行う方が認知機能にプラスの影響がみられています。

――認知症予防に新たな光明が見えているわけですね。

慢性疾患や障がいを持つ方や高齢者にも最適な運動方法を模索し、一人でも多くの人に楽しんでもらえるエクササイズを作っていきたいと、十数年前から取り組んできましたが、実はWHOが2020年に同様のことを推奨し始めました。ようやく時代が私たちに追いついてきたなと思っています。ここに栄養素の持つ機能性(認知機能への影響)をプラスして、より一層健康の維持・増進につながるモノとコトを開発していきたいと思っています。

◀マウスリンスの実効性を検証するために大阪マラソンに出場した弘原海教授

Professor Wadazumi participated in the Osaka Marathon to test the effectiveness of the mouth rinse.

コースの要所で採血し血糖値の変化を計測▶

Blood was drawn at key points along the course to measure changes in blood sugar levels.

―― Requirements for them overseas?

In 2022, I used a Kansai University system to go and study in France. When I was there, there weren't many exercise classes or activities for the elderly. When I taught the block exercises to people in an elderly community, they said they definitely wanted to spread the word. Recently, a lack of exercise among people who are constantly sitting down has become a global issue, in part due to the spread of working from home and the popularity of gaming among children. I believe that spreading the exercises will lead to the solution of such problems.

―― How do you plan to spread them?

By utilizing SNS. I am currently making exercise videos with students and uploading them to YouTube, but we are also planning to make English and Korean language versions and to distribute them to the world through various SNS media.

■Measuring the effectiveness of spray during the Osaka Marathon

―― In another area, you are also a leading researcher on "carbohydrate mouth rinse."

That is really my specialty, more than exercises. A carbohydrate mouth rinse is a liquid containing carbohydrates that is taken into the mouth and then spat out in order to improve exercise performance without taking an energy source into the body. In marathons and other competitive events that last for a long time, it is inevitable that energy will decrease and performance will decline. That is why carbohydrate supplementation before and during a race is essential. However, if you put things into your stomach or intestines, this places a strain on your body. This was why the mouth rinse method was devised, where the liquid is spat out without swallowing it.

In the beginning, my goal was to develop an effective sports drink. However, I came across the mouth rinse along the way and began to research it in earnest.

―― How have you conducted your research?

What I focused on was the method of the mouth rinse. The traditional method of spitting it out is a problem in terms of hygiene. However, I thought that we could solve that problem if we used spraying with a spray.

In cooperation with joint researchers and students, we repeatedly conducted experiments to compare the spray method with the conventional method of putting a liquid into the mouth and we verified the effectiveness. In the laboratory, we had subjects perform loaded exercise on a bicycle to reproduce the state known as the 35 km wall in a full marathon, which is where the energy in the body is depleted. We then investigated changes before and after spraying in aspects such as the blood glucose level and the exercise performance results. I also participated in the Osaka Marathon myself, took blood samples for blood sugar level measurement at key points, and performed spraying at the 35 km mark. By actually running myself, I experienced the harshness of a marathon and the effectiveness of the spray. Both of these experiments proved that there is no difference in effect between the method of putting liquid in the mouth and the spray method. When a doctoral student presented this in a paper in 2022, it was met with surprise from other researchers.

Incidentally, we are currently working with a major food company to develop a tablet type. We believe that using a small solid will make it possible to take it in smoothly, both physically and in terms of the time required.

■Expectations for a synergy that was so exciting it made my hands tremble

―― How will the research on the exercises and the mouth rinse progress in the future?

I believe that these two areas will have a synergistic effect on a particular matter, and I am conducting research on this. Namely, this is the impact on cognitive function. It is known that in addition to exercise, putting carbohydrates in the mouth also stimulates the brain. As with exercise, it activates the DLPFC (dorsolateral prefrontal cortex), which is a part of the brain that controls cognitive functions. When I discovered this fact in the literature I was reading when I first started creating the Sakai Co-kara exercises, my hands trembled with excitement when I realized that this was the same as for mouth rinse. In the experiments we have conducted so far, we have seen that performing a mouth rinse using spray during breaks creates a greater positive effect on cognitive function than just exercising alone.

―― So, you have cast new light on the prevention of dementia.

For more than a decade now, we have been working to find the best exercise methods for people with chronic diseases or disabilities, and for the elderly, and we have wanted to create exercises that can be enjoyed by as many people as possible. In fact, the WHO started recommending similar activities in 2020. I think the times are finally catching up with us. We would like to add the functionality (Effects on cognitive function) of nutrients to this, and to develop items and actions that will further contribute to the maintenance and improvement of health.