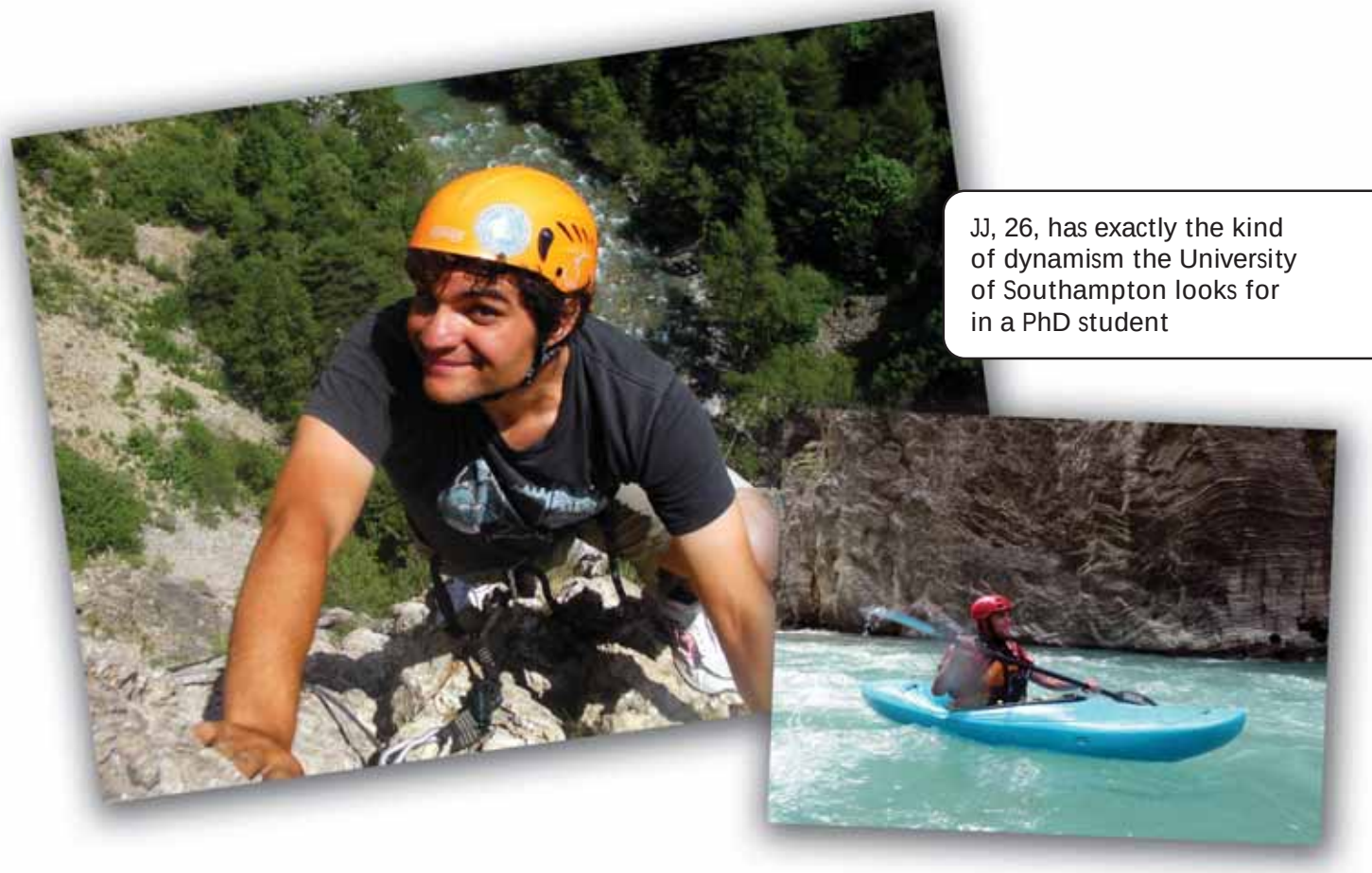


JJ, 26, has exactly the kind of dynamism the University of Southampton looks for in a PhD student

A **model** *student*

A background in engineering and computing isn't usually essential to diabetes research, but that's precisely why John 'JJ' Valletta bagged a Diabetes UK PhD Studentship. **Dr Eleanor Kennedy** reports

Diabetes UK has always recognised the importance of encouraging young students eager to forge a career in diabetes research. Over the years, the charity has awarded three-year PhD Studentships to many who have gone on to have a considerable impact in the field, and its recent awards look set to add further to this impressive roll call.

In October 2007, one such studentship was awarded to Dr Andrew Chipperfield and Professor Christopher Byrne at the University of Southampton. With an imposing title – 'Dynamic modelling of the effect of physical activity on capillary blood glucose concentration' – and a challenging workload, the two supervisors knew that they needed to find quite a different breed of student to undertake this piece of work.

"For this project, we didn't really want a student from a human biology background," explains Byrne, Professor of Endocrinology and Metabolism at the university's School of Medicine. "What we needed was someone with a mathematics or engineering qualification – someone who was already comfortable with the computer modelling aspects of the work and who ▷

could learn the biology more or less along the way."

Fortunately, he and Dr Chipperfield found someone very keen to do the project – John Joseph 'JJ' Valletta, a student with an undergraduate degree in Engineering from the University of Malta, and a Masters in Computing from the University of Sheffield. "He's the perfect PhD student," says Prof Byrne, "not just because of his training, but he's also really embraced the patient aspect of the study and gained valuable diabetes experience on the ground, which makes him quite unique."

JJ agrees: "Pretty much the only thing I can't do is take a patient's blood. I rely on the nurses to help me with that – in particular Research Sister Clare Grocott and the 'Orange' Team at the Wellcome Trust Clinical Research Facility – but everything else I've learned along the way. And being part of a diverse, multidisciplinary team like ours has really helped me understand the clinical side."

But what exactly does the project entail? A significant proportion of people with Type 1 diabetes find it difficult to maintain good blood glucose control. Improving a person's understanding of how their lifestyle, particularly physical activity, can affect their blood glucose levels is essential for good health and avoiding or reducing the long-term complications of diabetes. Prof Byrne's interests in fitness and fatness, and their link to future cardiovascular risk, made him want to investigate the relationship between blood glucose levels, physical activity and diabetes treatment.

Many previous studies have tried to model the relationships between insulin, diet, physical activity and blood glucose concentrations, but few have been much practical use outside research. The greatest difficulty has been accurately recording variations in the intensity and duration of physical activity. In this

The Borneo identity

Victoria Lee (Vicky), a diabetes specialist pharmacist who has had Type 1 diabetes since she was nine years old, saw a flyer asking for people to take part in the Southampton 'Dynamic modelling' project. She contacted Prof Byrne, who promptly invited her on board. She jumped at the chance, even though she'd never been involved in a clinical study before.

"I'd never really had much opportunity to travel, and my fiancé and I wanted to do a big trip," Vicky says. "All of this happened around the same time as I joined the trial." Never one to shy away from a challenge, however, she decided to take the study with her all the way to Borneo.

"I thought it would be beneficial to me and the researchers, as they would be able to see the impact of extreme exercise. The continuous blood glucose monitoring helped me feel a lot more confident, but coping in the jungle was still a daunting prospect. I still worried whether, between us, my partner and I had packed enough food for me to snack on. I also carried my normal blood testing kit as a back-up."

Before taking the equipment to Borneo, the investigators made sure that Vicky was thoroughly trained in using it all, and are delighted with the data she collected. Comparing her readings with those of the other study participants has allowed them to get a real feel for the impact of such extreme exercise on blood glucose levels, particularly in such heat and at high altitudes, as Vicky decided to hike up the highest mountain in South East Asia.

For Vicky, though, the results are probably even more valuable. "It was a great educator. I learned so much about how my body reacts to situations and particular environments. The biggest surprise for me

Victoria Lee took her part in the study to the extreme by climbing the highest mountain in South East Asia and trekking the jungle in Borneo

was how long-lasting the effects of any exercise are. I used to think the effects wore off after a few hours but I could see changes occurring even the following day."

Although the experience has made her a great advocate of research, and she certainly wants to get involved in future studies, for now it's all about arranging her honeymoon. "South Africa probably," she says. "And much less extreme!"

project, therefore, the 24 people recruited to take part were given SenseWear Pro3 Armbands, which allowed researchers, for the first time, to measure the amount of energy each person used in his or her normal routine on a day-to-day basis. These gadgets, however, are much more than just simple pedometers.

Clever bits of kit

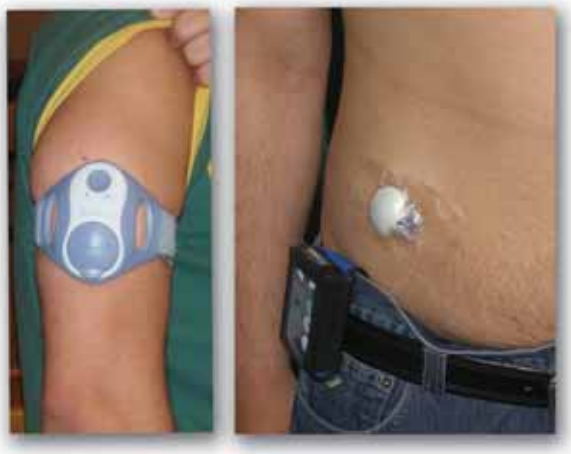
The Pro3 boasts an interesting array of sensors: heat flux sensors to record body temperature; a two-axis accelerometer to detect movement; and the impressive-sounding galvanic skin response, which records tiny changes in the electrical properties of the skin and can be used to measure stress. The armbands (see overleaf) not only provide the research team with general data on the effects of physical activity on blood glucose levels, but also with a range of highly detailed data recorded minute by minute. For example, the team will be able to look at the precise impact of increased heat on blood glucose levels or the relationship between electrical impulses across the skin and glucose concentration.

The participants also wear a continuous blood glucose monitoring device for one to two weeks at a time. This records and stores their blood glucose levels throughout the day. They also record their insulin injections and keep a diary of their food intake.

"The main benefit arising from our work will be an improved understanding of how an individual's quality of blood glucose control is influenced by their lifestyle, particularly by their level of physical activity," says JJ. "This could be of great significance for those people with Type 1 diabetes who suffer from poorer blood glucose control, as it might allow more effective therapies to be designed or motivate people to make positive lifestyle changes."

But that's not all. "With quite literally thousands of data points ▷

"It might allow more effective therapies to be designed or motivate people to make positive lifestyle changes"



A glucose sensor, right, and the SenseWear Armbands, which measure how much energy the wearer uses in a day

collected from each patient," JJ continues, "we'll be able to design the best mathematical models to show, with the greatest accuracy, the relationship between the patterns of a person's physical activity and the corresponding changes in their blood glucose concentrations. And we'll be able to look at these variations as they occur on a daily, weekly, monthly and even seasonal basis."

It is well recognised that promoting changes in lifestyle is essential to treating diabetes in general. Physical activity is encouraged because it lowers blood glucose levels during and after exercise, and increases the body's use of insulin. But this is also true for people with Type 2 diabetes, so why did the researchers only study people with Type 1?

"We decided to recruit only people with Type 1 diabetes," Prof Byrne says, "because we reasoned that we would get a much wider age range of people who engaged in varying levels of physical activity compared to people with Type 2 diabetes. People with Type 1 diabetes would also be less likely to be taking other medication that would affect their blood glucose concentrations."

Obviously, this is a project with long-term goals, so what do the team hope to achieve?

"Firstly, we'll be able to get vital information on the sensitivity and usefulness of the sensors in a number of settings," says Dr Chipperfield, Senior Lecturer in Computational Methods. "But one of our goals will be to secure funding to expand this research into Type 2 diabetes. Once we have cracked the modelling for Type 1 diabetes, it will be easier to investigate how applicable our system is to Type 2 diabetes, which may be complicated by the presence of other medications."

Spectacular success

The hope is that this pilot study will tell us a great deal about the role of physical activity in the care and treatment of Type 1 diabetes, including designing activity programmes tailored to meet the specific needs of different groups and individuals. Ultimately, such patient-specific models, as they are developed and fine-tuned over time, may offer us a technique for the early detection of diabetes-related complications.

This is just the kind of challenge JJ looks for. The project is well under way and, in the words of his supervisors, has been a "spectacular success". With a publication already under his belt and offers to collaborate with other groups in Europe, JJ would love to stay in the field.

"It's great to be working in such an innovative area, where engineering and biology meet. With engineering, if you break a machine, you can fix it. But with conditions like diabetes, you can't just fix it. You need to be much cleverer in the way you approach problems. And that's what this work is all about."

In the meantime, fittingly, JJ will be spending his time white water kayaking. "And if it's raining," he says, "you'll find me in Dartmoor."

Balance will, of course, keep you posted. □

Further information

If you would like to help support Diabetes UK research projects like this one, please call Supporter Services on 0845 123 2399 or go to www.diabetes.org.uk/regulargift