Institution: University of Exeter

Unit of Assessment: Sport and Exercise Sciences, Leisure and Tourism

Title of case study: Extending the evidence-base for the effects of physical activity on mental health and nicotine addiction.

1.Summary of the impact

Professor Adrian Taylor and colleagues in Exeter Sport and Health Sciences (SHS) have conducted: (1) laboratory studies to identify the dose of exercise that is sufficient to acutely impact on affect, mood and smoking-related outcomes; (2) rigorous randomised controlled trials to evaluate chronic interventions to increase physical activity among depressed patients, and smokers wishing to reduce or quit; and (3) rigorous systematic reviews and meta-analyses to inform guidance for health care practitioners and policy makers. This work has significantly contributed to the evidence-base underpinning global health care policy guidelines (including those produced by the National Institute for Health and Care Excellence (NICE)), as well as raising global media interest, informing public debate and clinically supporting patients and practitioners on best practice. Commissioned reviews have also identified gaps in the evidence-base for the effects of physical activity on mental health and nicotine addiction which has led to the prioritisation of funding for further research to resolve uncertainty in clinical guidelines.

2. Underpinning research

Physical activity is beneficial for health but less is known about how to effectively increase physical activity within health care services, directed at those with mental health problems such as depression and addictions. Depression and smoking cost society an estimated £8bn and £13.8bn per year, respectively, in England alone. Over 50% of patients relapse following recovery from depression, and over 80% of smokers relapse after attempting to quit, within a year. An evidence base is required to support policy, practitioners and the public on if exercise is useful for these conditions and what support is effective to help patients increase and maintain physical activity. Research carried out by Taylor (joined Exeter University, September, 2003) spans phases from pre-clinical and theory building to evaluation within randomised controlled trials (RCTs), and evidence synthesis. The research has significantly contributed to what we know about the effects of acute and chronic exercise interventions for patients with depression and smokers, and how to increase and maintain physical activity.

Most exercise interventions targeted at smokers wishing to quit smoking have involved supervised sessions lasting 40+ min, on 2-3 days per week, to increase aerobic fitness. Only one study, as revealed in our 2008 review [1], showed effects on increasing long-term abstinence. In 2007 the first systematic review of the literature [2], including 3 of our own original studies, showed that a short single bout of brisk walking, compared with passive controls, reduced cravings and smoking-cue reactivity. In response to global media interest, and questions about the mechanisms, our subsequent acute studies have shown that physical activity reduces attentional bias to and salience of smoking images, using video and still images and functional magnetic resonance imagery of the brain. We integrated the promotion of short bouts of physical activity to manage cravings into a standard smoking cessation programme [3] through 2 years of collaborative action research involving both NHS Stop Smoking Service advisors and approximately 140 smokers (in Plymouth & Birmingham), to develop a way to integrate physical activity support into routine care, using our self-help 'Walk-2-Quit' guide. This work fed into a pilot RCT to examine the effects of Health Trainer delivered Exercise Assisted Reduction to Stop behavioural support among 99 disadvantaged smokers (in neighbourhoods in Plymouth which are among the 3% most deprived in England) who wished to reduce their smoking but not quit. Over 3 times as many quit in our intervention v. control group. Our intervention cost £192 per participant, and exploratory cost-effectiveness modelling indicated this would provide huge financial savings for health services.

Our NIHR-HTA funded systematic review of RCTs revealed that exercise referral schemes (ERS) have only a small, if any, benefit for increasing long-term physical activity and reducing depression [4], contrary to NICE clinical guideline CG90. In 2005, Taylor and colleagues at Bristol (Haase, Fox & Lewis) developed an 8 month counselling intervention to facilitate increases in physical activity for depressed patients, to be rolled out into the NHS if effective and acceptable to patients. It drew on principles of motivational interviewing and cognitive behavioural therapy to

enhance Self-Determination Theory constructs of competence, autonomy and relatedness [5]. Within a NIHR-HTA funded RCT we showed that the intervention (offered to 161 depressed patients) increased physical activity, but did not reduce depression, compared with usual care [6].

3. References to the research

Evidence of the quality of the research comes from the fact that all outputs were derived from externally funded grants, and published in rigorous peer reviewed international journals. Cochrane Reviews are systematic reviews of primary research in human health care and health policy, are internationally recognised as the highest standard in evidence-based health care and seek to establish whether or not there is conclusive evidence about a specific treatment.

1. Ussher MH, Taylor A.H. & Faulkner G. (2008). Exercise interventions for smoking cessation. *Cochrane Database of Systematic Reviews*, (4):CD002295. DOI: 10.1002/14651858.CD002295.pub3 (66 citations).
2. Taylor, A.H., Ussher, M., & Faulkner, G. (2007). The acute effects of exercise on cigarette cravings, withdrawal symptoms, affect and smoking behaviour: A systematic review. *Addiction*, 102, 534-543. DOI:10.1111/j.1360-0443.2006.01739.x (92 citations).
3. Taylor, A.H., Everson-Hock, E. S. & Ussher, M. (2010). Integrating the promotion of physical activity within a smoking cessation program: findings from collaborative action research in UK Stop Smoking Services. *BMC Health Services Research*, 10, 317. DOI:10.1186/1472-6963-10-317 (4 citations).
4. Pavey, T.G., Taylor, A.H., Fox, K.R., Hillsdon, M., Anokye, N., Campbell, J.L., Foster, C., Green, C., Moxham, T., Mutrie, N., Searle, J., Trueman, P. & Taylor, R.S. (2011). Effect of exercise referral schemes in primary care on physical activity and improving health outcomes: systematic review and meta-analysis. *British Medical Journal*, Nov 4;343:d6462. DOI: 10.1136/bmj.d6462 (16 citations).
5. Haase, A.M., Taylor, A.H., Fox, K.R., Thorp, H. & Lewis, G. (2010). Rationale and development of the physical activity counselling intervention for a pragmatic TRial of Exercise and Depression in the UK (TREAD-UK). *Mental Health & Physical Activity,* 3, 85-91. (3 citations).
6. Chalder, M., Wiles, N.J., Campbell, J. Hollinghurst, S.P., Haase, A.M., Taylor, A.H., Fox, K.R., et al (2012). Facilitated physical activity as a treatment for depressed adults: randomised controlled trial. *British Medical Journal*, Jun 6;344:e2758. DOI:10.1136/bmj.e2758 (21 citations).

Outputs 1-3 were derived from two grants as follows: Knowledge Synthesis Project, Canadian Tobacco Control Research Initiative (Ca $64k). '*Exercise as an aid for smoking cessation: A review of effectiveness and efficacy'*. G. Faulkner (University of Toronto), A.H. Taylor et al. (2004-6); National Prevention Research Initiative - 1 (MRC & 10 partners). '*Walking as an aid to smoking cessation: a feasibility study in an NHS Stop Smoking Service.*' (£68.5k) A.H. Taylor (PI) & M. Ussher (co-applicant, University of London) (2006-7). Pilot work described in Output 3 also led to funding of: NIHR (Health Technology Assessment; HTA). Grant HTA 07/78/02 (£435,536). '*An exploratory trial to evaluate the effects of a physical activity intervention as a smoking cessation induction and cessation aid among the 'hard to reach.*' A.H. Taylor (PI) et al. (2010-12).
Output 4 was derived from NIHR HTA Project: 08/72/01. (2009-11)(£160k). '*The Clinical and Cost Effectiveness of Exercise Referral Systems: A Systematic Review and Economic evaluation*.' R. Taylor (Exeter University Medical School) & A.H. Taylor (SHS)(Co-P.I's), and co-applicants.
Outputs 5-6 was derived from NIHR (HTA) grant: 03/45/07. (2006-11). '*A pragmatic randomised controlled trial (TREAD) to evaluate exercise prescription as a treatment for depression*.' (PI: Glyn Lewis (U. of Bristol)(Co-applicants: A.H. Taylor (Exeter), et al. £107k of £904k (total funding) for Exeter intervention development and physical activity facilitator supervision. TREAD experiences led to a successful MRC (NPRI-4) bid for a pilot trial (integrating Behavioural Activation and Physical Activity: BAcPAc) with depressed patients seeking NHS treatment. (http://bit.ly/1bERJnS).

4. Details of the impact (Note: Bracketed numbers and letters refer to Section 3 and 5, respectively)

Exeter's research on exercise and smoking cessation has had impact in three important ways: (1) informing global health care policy guidelines, (2) generating global media interest and informing

public debate and (3) providing clinical support for patients and practitioners on best practice.

(1) Informing global health care policy guidelines

Our Cochrane Review [1] has been cited by organisations around the world in guidelines on the use of formal exercise interventions to support smoking cessation (e.g., by Royal Australian College of General Practitioners Australia [A], and by the National Centre for Smoking Cessation and Training in the UK [B]). The absence of clear evidence for the effectiveness of exercise interventions to improve long-term abstinence is noted. Output [2] has been widely cited as evidence that a short bout of moderate intensity exercise such as walking can temporarily reduce cravings and withdrawal symptoms (e.g., US Surgeon General's 2008 guide on 'Treating Tobacco Use and Dependence' [C]). This citation has influenced the adoption of this source by a wide range of charities and other organisations offering support to smokers.

Impact on public policy is further demonstrated through Output [4] which directly influenced the NICE decision in September 2012 to update their '2006 Review of the public health guidance (PH2); Four commonly used methods to increase physical activity (including 'Exercise Referral Schemes')' [D]. Our review provided new information on exercise referral scheme effectiveness, determinants of uptake and adherence, and cost-effectiveness, and highlighted the need for further research on interventions to increase uptake and adherence, among patients with medical conditions. As a result, The NIHR-HTA invited bids to evaluate the effectiveness and cost-effectiveness of new ways to increase uptake and adherence of exercise referral schemes, (see *http://bit.ly/1aIgEWw*). As part of our own bid, we have engaged with over 60 exercise practitioners and local policy makers on a needs assessment, and content and format of augmented Exercise Referral Schemes.

(2) Generating global media interest and informing public debate

Exeter's research on aspects of the acute effects of exercise has informed public debate, and generated interviews and reports. Output [2] has been widely cited on websites for helping people to change smoking behaviour (e.g., Ontario Lung Association, Canada: Quit and Get Fit Fact Sheet) [E] and also on health-related websites for smokers (e.g. CVS pharmacy [F], 'Boots' WebMD – *http://bit.ly/1joU8Y6*, Cancer Institute, New South Wales, - *http://bit.ly/1hZb9wl*, NHS Choices (*http://bit.ly/1ixjmpi*).

Significant public debate was generated from Output [6] which arose, in part, from a mis-reported headline on the BBC website. There were 55,000 full text on-line downloads of the BMJ article in the first year, and 31 global responses (up to 11/2013) [G] (e.g., from the UK, Japan, India, Pakistan, Brazil, Austria, Ireland, USA) from an equal mix of academics, patients and practitioners. This is the largest trial of the effects of a facilitated physical activity intervention for depressed patients in primary care in the world, to date, and the findings generated public debate about differences between trials to test the efficacy of exercise for treating depression versus the effectiveness of pragmatic behaviour change interventions that could be rolled out in a health service (see a Guest Blog on Scientific American webpage [H]).

(3) Providing clinical support for patients and practitioners on best practice

Exeter's research has impacted on the development of practitioner led evidence-based interventions that can help smokers to quit. The findings in outputs [1-3] were disseminated in invited presentations to over 600 Health and Stop Smoking Service managers and practitioners throughout the UK (e.g., Plymouth Stop Smoking Service; Kings Fund 'Improving health outcomes - why clusters of lifestyle behaviours matter', March 2012); Bristol Stop Smoking Advisor conference, 2012; ASH-Wales conference, Cardiff, 2012; ASH-Scotland workshop, Glasgow, 2013). Importantly, there have been many examples of local Stop Smoking Services who have applied information from Outputs [1-3] by adding a physical activity intervention into routine support such as with structured exercise (e.g., Fife), walking schemes (e.g., Coventry), free gym vouchers (Plymouth), and using pedometers and goal setting (e.g., Bureau of Chronic Disease Prevention & Tobacco Control, New York City Department of Health & Mental Hygiene).

As part of our strategy to increase the evidence-base for exercise as a treatment for nicotine addiction we have successfully lobbied the NIHR-HTA to prioritise future funding to fill gaps identified in Output [1], which has led to an impact on practitioner practice and public engagement.

Outputs [2, 3] directly influenced the physical activity support interventions offered by mid-wives to 361 pregnant smokers (see: http://bit.ly/1j9zYkH) in the LEAP trial, and by Health Trainers to 49 disadvantaged smokers who wanted to reduce but not quit (11 of whom did attempt to quit) (see http://bit.ly/1auwLdH) in the EARS trial.

Translating evidence into practice through the development of pragmatic physical activity behaviour change interventions for patients with depression has been a key focus of our research. The intervention described in Output [5] was delivered by eight trained practitioners to 182 patients with depression from 65 NHS GP surgeries in and around Exeter and Bristol, and related work (e.g., http://1.usa.gov/I6p5VM) gave us a unique understanding of practitioner and patient views. As a consequence, Taylor was invited to develop and twice deliver (to >20 exercise practitioners in Dudley and Londonderry) a national Wright Foundation 3-day Level 4 Mental Health course (http://bit.ly/1aXMnck), and provided invited input into the development of the Level 4 National Occupational Standard: Physical Activity and Health – Adult Mental health service users. 'Skills Active' (http://bit.ly/19qj77y). Since 2008, Taylor has been an invited speaker at a range of practitioner-based events on physical activity and depression (e.g, Devon Partnership Trust with over 30 delegates, St Andrews Hospital Healthcare (UK's largest charity providing specialist mental health services) with over 200 delegates, Wright Foundation Annual Conference with >400 delegates, Somerset MIND conference with over 70 practitioners and service users, and invited international workshops for over 100 delegates – in Norway, Turkey, Austria, USA). Taylor was also invited to write a web-based leaflet on physical activity and mental health for the Royal College of Psychiatrists [J] which, with over 15,000 hits in the first year, is one of their highest user-rated leaflets. The leaflet focused on the core principles and theoretical underpinnings used in TREAD, including support for self-determined behaviour, overcoming barriers, and enhancing self-efficacy and outcome expectancy.

Intervention development work reported in Output [5] led to the invited publication of practitioner and policy-based outputs in the Journal of the Royal College of Physicians, Edinburgh (Donaghy & Taylor, 2010, DOI: 10.4997/JRCPE.2010.223) and the Oxford Guide to Low Intensity CBT Interventions (Editors: Lau & Bennett-Levy). Our NPRI-4 funded BAcPAc study, arising from Outputs [5, 6], led to the training of ten Psychological Well-being Practitioners working with depressed patients within Devon's Improving Access to Psychological Therapies Service.

5. Sources to corroborate the impact

A) Zwar N, et al (2011) Supporting smoking cessation: a guide for health professionals. Melbourne: The Royal Australian College of General Practitioners. http://bit.ly/1hLtflB

B) The National Centre for Smoking Cessation and Training (NCSCT). http://bit.ly/HQtyLs

C) US Dept of Health & Human Services, Treating *Tobacco* Use & Dependence: 2008 Update (http://1.usa.gov/1bAcMv4)

D) Decision by NICE to update their review the effectiveness of exercise referral schemes (http://bit.ly/HXjVLA).

E) Ontario Lung Association Quit & Get Fit Fact Sheet. http://bit.ly/1ig9m3S

F) CVS Pharmacy on-line support for smoking cessation http://bit.ly/1hLtugq

G) BMJ website: http://bit.ly/HXjWiN for article metrics and 31 responses to the article from around the world.

H) Guest Blog on Scientific American website (see (http://bit.ly/1e84Phh)

I) Letter from the Medical Director, Clinical & Scientific Affairs Unit, Bureau of Chronic Disease Prevention & Tobacco Control, NYC Department of Health & Mental Hygiene (http://on.nyc.gov/1aIhySP).

J) Royal College of Psychiatry – Physical Activity and Mental Health Leaflet. Website cites Taylor. http://bit.ly/17XDJKH)