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### Preventing mental illness among young people: opportunities emerging from systems-based obesity prevention

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**Background:** It is widely accepted that the antecedents to mental illness are varied and complex, and early life is critical for intervention and prevention. Evidence points to lifestyle behavioural risk factors, in particularly diet and physical activity, as targets for prevention of depression and anxiety among young people. Opportunity exists to leverage upon existing obesity prevention interventions, which adopt a systems perspective to account for complexity in diet and physical activity behaviours, to promote positive mental health and well-being.

**Methods:** A series of obesity prevention trials are currently underway throughout Victoria, to build capacity and develop community-led interventions to promote healthy eating and physical activity. Systems science is applied through the development of causal loop diagrams to identify the interconnections between diet, physical activity and associated barriers and enablers to young people's health.

**Results:** The initial pilot study (2012–2014) found a significant decrease in depressive symptomatology (26% to 17%) over two years in an intervention community that incorporated mental health objectives, alongside diet and physical activity-related goals. Baseline findings from Victorian communities indicated that emotional, school, social and physical functioning are significantly associated to obesogenic risk behaviours among primary school students, and sex-specific associations exist.

**Discussion:** A systems approach which assumes complexity in underlying causes holds great promise for prevention of mental disorders. This research program will identify the potential for systems-based obesity prevention interventions for the dual benefits of mental disorder prevention. Pilot findings are promising, however further research is needed including the measurement of system changes, the ways in which mental health specific objectives are included, and defining mechanistic pathways. Incorporating mental health as a specific objective within interventions aiming to facilitate nutrition and physical activity among young people is warranted.

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### National monitoring of diet and activity among Australian secondary students: the NaSSDA survey

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### Teens, diet, and physical activity: Knowledge, attitudes, and perceived trade-offs

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As reflected in numerous behavioural theories, knowledge and attitudes are key determinants of whether individuals engage in health-related behaviours. These factors are likely to be especially relevant where recommended behaviours require effort, are considered unappealing, and/or have strong competition. The aim of this study was to assess knowledge and attitudes relating to diet and physical activity among Australian teenagers to inform future interventions to improve health outcomes in this group. Of particular interest was whether similar knowledge and attitudinal outcomes were apparent between the domains of PA and nutrition. Eight focus groups were conducted with 72 teenagers (12–17 years of age) in Western Australia. The groups ran for an average of 80 min. The sessions were audio-recorded and the resulting transcriptions were imported into NVivo for analysis. Most of the participants could cite specific nutrition guidelines (e.g., consume 2 fruits and 5 vegetables per day), differentiate between healthy and unhealthy foods, and discuss at length why a healthy diet is important. By comparison, few could nominate the recommended level of PA for their age group (60 min/day) and they appeared much less certain about what kinds of exercise are recommended and why. It was generally considered easier to eat healthily than to engage in regular PA, largely because of the many other perceived demands on their time and the amount of sedentary time spent using various forms of media. In conclusion, while generally appreciative of the importance of PA, teenagers may lack the level of understanding needed to motivate engagement in recommended levels of activity. Specific suggestions for future interventions designed to cater for this population segment will be discussed. The study was funded by the WA Health Promotion Foundation (Healthway).

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### Energy drink consumption among Australian adolescents occurs amidst a cluster of unhealthy behaviours

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**Background:** Non-alcoholic energy drinks ('energy drinks') are high in caffeine and sugar, leading to concerns regarding their suitability for young people. Despite this, marketing of energy drinks is often directed at adolescents, and there are no restrictions on the sale of these products.

**Aim:** To examine patterns in consumption of energy drinks among Australian secondary school students and identify demographic and behavioural correlates associated with weekly consumption.

**Methods:** Cross-sectional survey of 8,888 students in Years 8 to 11 (aged 12–17 years) who participated in the 2012–13 National Secondary Students' Diet and Activity (NaSSDA) survey. Students' self-completed an online questionnaire assessing their eating, physical activity and sedentary behaviours and their height and weight was measured.

**Results:** Overall, 13% of students reported consuming energy drinks on a weekly basis. A further 18% indicated that they consume less than a cup a week of these types of drinks, while just over two-thirds (69%) reported that they do not consume energy drinks. In multivariable analysis, weekly consumption of energy drinks was independently associated with male gender, lower socio-economic position (SEP), having at least \$40 per week of spending money; high intakes of fast food and other sugar-sweetened beverages, and short sleep duration. There was no independent association with body weight or other demographic characteristics (i.e. year level, geographic location), eating behaviours (i.e. consumption of vegetables, fruit, snack foods or fruit juice), or physical activity and television viewing habits.

**Conclusion:** While the majority of adolescents do not consume energy drinks, regular consumption is more prevalent among low SEP males and appears to cluster with other unhealthy behaviours. Given there is growing evidence of the potential health harms of energy drinks for young people, improved education is needed along with restrictions on the marketing and sale of these products to adolescents.

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### Role of amygdala NPY in the development of stress-induced obesity



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Neuropeptide Y (NPY) is one of the most powerful orexigenic peptides known, exerting critical feeding related functions in the hypothalamus. However, NPY is also present in extra hypothalamic nuclei where it is modulated in response to metabolic and other physiological perturbations, but far less is known about these NPY populations and their influence on energy homeostasis regulation. Now we have identified that NPY neurons in the central amygdala (CeA) are responsible for an exacerbated response to a combined stress and high fat diet intervention leading to accelerated obesity development. Employing CeA NPY neuron specific AAV-NPY overexpression models we were able to replicate the obese phenotype seen in the combined stress/HFD mouse model, which was prevented by the selective ablation of NPY from these neurons. Furthermore, by selectively activating NPY neurons of the CeA via DREADD we mapped the projections of these neurons to the Arc and PVN, known nuclei to be critical for energy homeostasis control. Moreover, using food intake and energy expenditure as the physiological readout we demonstrated that selective activation of CeA NPY neurons results in a robust increase in food intake and decrease in EE which is entirely dependent on the presence of NPY. Mechanistically it is the failure of insulin to no longer control these NPY neurons under combined stress/HFD conditions that leads to accelerated obesity. Taken together this study has uncovered a previously unknown feeding stimulatory pathway that is activated under conditions of stress in combination with calorie dense food.

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### Brain control of blood glucose

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### AgRP neurons require carnitine acetyltransferase (Crat) to regulate metabolic flexibility and peripheral nutrient partitioning



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### Osteoglycin, a novel coordinator of bone and glucose homeostasis



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The importance of coordinating whole body energy balance is known, however, the mechanism controlling and integrating the energy homeostasis of individual tissues during weight change is unclear. Employing transcriptomic and proteomic analysis of Y1 receptor deficient osteoblasts combined with the generation of a genetically modified mouse model we have identified a novel circuitry that is responsible for coordinating bone accretion with changes in energy balance and identify the NPY controlled release of osteoglycin from osteoblasts as the critical component. Osteoglycin acts to suppress bone formation when energy levels are low and to modulate whole body energy supplies by altering glucose uptake through changes in insulin secretion and sensitivity, as well as by altering food intake through central signalling. Human studies show that osteoglycin is associated with BMI and lean mass as well as changes in weight, BMI and glucose levels as a result of the negative energy balance elicited by gastric surgery. Thus, we identify osteoglycin as a novel factor facilitating matching of bone acquisition to alterations in energy status.

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