EVIDENCE-BASED PUBLIC HEALTH POLICY AND PRACTICE

Healthy lifestyle choices: could sense of coherence aid health promotion?

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Background: A research framework based on the personal characteristic defined by a sense of coherence (SOC) focuses on the effective use of resources to maintain good health.
Objectives: To test the hypothesis that individual differences in SOC are associated with healthier lifestyle choices independently of social class and education.
Design and setting: Cross sectional. Population based cohort study recruited through 35 general practice registers. Reported dietary intakes of alcohol, fruit and vegetables, fibre, saturated fat, non-discretionary salt (sodium), and total sugars were assessed by food frequency questionnaire. Current cigarette smoking, physical inactivity, and SOC were assessed through questionnaires.
Participants: 7863 men and 10 424 women. Residents of Norfolk (UK).
Results: Compared with participants with the weakest SOC, those with the strongest were 28% less likely to be current smokers (odds ratio 0.72 (95% confidence interval (CI), 0.58 to 0.89)), 36% less likely to be physically inactive (0.64 (0.55 to 0.75)), and reportedly consumed on average 63 g/day more fruit and vegetables (95% CI, 46 to 80), and 1.2 g/day more fibre (0.8 to 1.6). These associations were independent of age, sex, social class, and education. For physical inactivity and consumption of fruit, vegetables, and fibre, these differences exceeded those observed between the extremes of social class and education.
Conclusions: Individual differences in SOC are associated with healthy lifestyle choices independently of social class and education, and may therefore aid the design of future health promotion interventions.

Poor diet, physical inactivity, cigarette smoking, and excessive alcohol consumption are major causes of morbidity and mortality in the United Kingdom, and have a huge impact on the NHS.[1 2] In England, ten million adults currently smoke cigarettes, six million drink more alcohol than the Government's recommended daily guidelines, and six of 10 men and seven of 10 women are not active enough to have significant benefit for their health.[1] The typical UK adult diet does not meet current government guidelines that would require greater consumption of fruit, vegetables, and fibre, and lower consumption of salt, saturated fat, and sugar.[2] It has been estimated that increasing the consumption of fruit and vegetables alone, from the current level of 2.8 portions a day up to five portions a day, could reduce the risk of death from chronic diseases (such as heart disease, stroke and cancer) by as much as 20%.[2]

Sense of coherence (SOC) is a theoretical construct defined to represent the belief that what happens in life is comprehensible, manageable, and meaningful, and hypothesised as a flexible and adaptive dispositional orientation that enables successful coping with adverse experience and the maintenance of good health.[3] A strong SOC defines a way of thinking that enables people to identify and use the resources that are available to them,[4] and has been shown to be associated with better perceived and self reported health,[5 6] with lower rates of circulatory illness,[7] coronary heart disease,[8] and mortality[9 10] (see Eriksson and Lindström[11] for a recent review). Studies have suggested that a strong SOC is associated with higher levels of physical exercise,[12 13] lower rates of alcohol problems,[14] lower rates of cigarette smoking,[15] and with healthier food choices.[16] SOC may therefore provide an important focus to aid lifestyle modification.

Based on data collected from participants in the Norfolk (UK) European Investigation into Cancer (EPIC-Norfolk) study,[17] we investigate the associations between SOC and cigarette smoking, alcohol consumption, physical inactivity, and dietary intake of fruit, vegetables, fibre, saturated fat, salt, and sugar. As SOC has been shown to be associated with socioeconomic status,[18 19] and the social gradients in both health[20–22] and health behaviours[1 20 23] are well recognised, a more specific aim was therefore to investigate whether associations are independent of both social class and education.

METHODS

Participants and measures

Residents of Norfolk (UK) were recruited during 1993 to 1997 into the EPIC-Norfolk study using general practice age–sex registers.[17 24] The study was approved by the Norwich District Health Authority ethics committee, and all participants gave signed informed consent. Baseline assessment included details of physician diagnosed diabetes, heart attack or stroke, together with an assessment of current and lifetime cigarette smoking behaviour, social class, and education. Smoking history was derived from yes/no responses to the questions ''Have you ever smoked as much as one cigarette a day for as long as a year?'' and ''Do you smoke cigarettes now?''. Social class was classified according to the Registrar General's occupation based classification scheme (see Shohaimi *et al*[25] for further details). Educational status was based on the highest qualification attained. A validated physical activity index was derived from two questions on past year work and recreational activities, and coded as physically inactive, moderately inactive, moderately active, and active.[26] Participants completed a semiquantitative food frequency questionnaire (FFQ) designed to measure the average consumption of 131 food items over the previous

Abbreviations: FFQ, food frequency questionnaire; HLEQ, health and life experiences questionnaire; SOC, sense of coherence

Table 1 Health behaviours according to weak and strong sense of coherence

	A			B		
	SOC			SOC		
Variable	Weak	Strong	p Value	Weak	Strong	p Value
Men						
Cigarette smoking (% current)	11.8	9.3	0.0002	10.5	9.1	0.03
Alcohol (units/week)	8.4	9.9	<0.0001	10.1	11.2	0.002
Physical exercise (% inactive)	28.0	24.4	0.0003	40.9	36.4	0.0002
Diet						
Fruit and vegetables (g/d)	369.6	406.8	<0.0001	360.8	392.0	<0.0001
Fibre (g/d)	16.5	17.2	<0.0001	16.5	17.0	<0.0001
Saturated fat (g/d)	28.9	28.5	0.05	29.0	28.7	0.18
Sugar (g/d)	124.5	125.0	0.54	124.4	124.9	0.51
Salt (mg Na/d)	2745	2727	0.17	2705	2693	0.36
Women						
Cigarette smoking (% current)	12.0	9.5	0.0001	11.4	9.5	0.003
Alcohol (units/week)	4.4	5.5	<0.0001	4.5	5.2	<0.0001
Physical exercise (% inactive)	26.4	21.8	<0.0001	29.8	25.8	<0.0001
Diet						
Fruit and vegetables (g/d)	511.7	549.3	<0.0001	496.2	527.2	<0.0001
Fibre (g/d)	19.4	20.1	<0.0001	19.1	19.6	<0.0001
Saturated fat (g/d)	27.8	27.5	0.03	28.0	27.7	0.05
Sugar (g/d)	134.5	135.2	0.24	133.2	134.3	0.09
Salt (mg Na/d)	2782	2800	0.08	2795	2807	0.26

A, adjusted for age; B, adjusted for age, social class, education (presented for age group 60 to 64, social class III non-manual and educated to age 16). Measures obtained from the FFQ are additionally adjusted for total energy intake, height, and weight.
FFQ, food frequency questionnaire; SOC, sense of coherence.

year.[27 28] Food and nutrient intakes in grams, including total energy intake, and consumption of fruit, vegetables, fibre, saturated fat, non-discretionary sodium, total sugars, and alcohol, were derived from the intake of all food items reported in the questionnaire. During 1996 to 2000 a total of 20 921 participants (of 28 582 eligible in EPIC-Norfolk) completed the health and life experiences questionnaire (HLEQ),[10] an assessment of social and psychological circumstances. The HLEQ included a three item SOC scale[7 29] designed to assess each of the component constructs (comprehensibility, manageability, and meaningfulness) by single questions, namely: ''Do you usually feel that the things that happen to you in your daily life are hard to understand?'' (comprehensibility), ''Do you usually see a solution to problems and difficulties that other people find hopeless?'' (manageability), and ''Do you usually feel that your daily life is a source of personal satisfaction?'' (meaningfulness). Response choice was ''yes, usually'' (scored 0); ''yes, sometimes'' (scored 1); and ''no'' (scored 2). Following reverse scoring for comprehensibility, all items were summed to provide a total SOC scale score within the range 0 to 6 with a higher score representing a weaker SOC.

Statistical analysis

Participants who reported pre-existing cancer, myocardial infarction, stroke, or diabetes at study baseline were excluded from all analyses. Associations were investigated between SOC and current cigarette smoking, physical inactivity, units of alcohol consumed per week (where one unit equals 8 g of alcohol), and dietary intake of fruit and vegetables, fibre, saturated fat, and sugar (all as g/day) and salt in food (mg/day of sodium). Results are presented by sex as adjusted means (for continuous measures) and adjusted percentages (for binary measures), according to whether participants reported weak or strong SOC (defined previously as weak by scale scores 2 to 6, and strong by scale scores 0 or 1[19]), and derived from linear regression (for continuous measures) and logistic regression (for binary measures). Results were adjusted first for age (as a categorical variable in five year age bands), and second for age, social class (I, II, III non-manual, III manual, IV, and V) and education (no qualifications, to age 16, to age 18, degree level). Variables derived from the FFQ were additionally adjusted (throughout) for height, weight, and total energy intake (kJ/day). Dose–response relations between SOC and selected health behaviours are presented as adjusted means/percentages according to increasing SOC scale score (0, 1, 2, 3, and 4 to 6, with these three categories pooled owing to smaller cell sizes), for men and women combined, and with adjustment for age, sex, social class, and education. Finally, dose–response associations by increasing SOC scale score are presented graphically, stratified according to combined social class and education groups, and adjusted for age and sex (and energy intake), where social class was dichotomised as low by groups III manual, IV and V, and high by groups I, II, and III non-manual, and education as low by no qualifications or educated to age 16 and high by being educated to age 18 or to degree level.

RESULTS

Completed SOC scale scores were available for 20 579 (of 20 921) EPIC-Norfolk HLEQ study participants (mean 1.84, SD 1.15). Women reported weaker SOC than men (mean score 1.68 for men and 1.96 for women, $p<0.0001$) and mean SOC scores were 1.88, 1.86, 1.78, and 1.88 for participants aged 41 to 49, 50 to 59, 60 to 69, and 70 to 80, respectively ($p = 0.33$ for test of trend). SOC varied substantially according to both social class and education such that those in the lowest social classes, and those who were least educated, had weaker SOC (mean SOC 1.57, 1.67, 1.96, 1.92, 2.05, and 2.25 for participants in social classes I, II, III non-manual, III manual, IV and V, respectively ($p<0.0001$), and 2.03, 1.90, 1.73, and 1.49 for those with no qualifications, educated to age 16, to age 18, and to degree level, respectively ($p<0.0001$)). After exclusion of participants with pre-existing disease at baseline, a sample of 18 287 participants was available for analysis, including 7863 men and 10 424 women.

Table 1 shows the associations between SOC and health behaviours. For both men and women, participants who reported strong SOC were less likely to be current smokers, less likely to be physically inactive, and reportedly consumed more fruit, vegetables, and fibre, though more alcohol, than participants who reported weak SOC. These associations were

Table 2 Dose–response associations between sense of coherence (0 = strongest, 4–6 = weakest) and health behaviours, adjusted for age, sex, social class, and education (presented for age 60 to 64, social class III non-manual, educated to age 16, and as mean value for men and women)

	SOC					
	0 (n = 2036)	1 (n = 5662)	2 (n = 5680)	3 (n = 3438)	4–6 (n = 1471)	p Value
Cigarette smokers (% current)	9.9	9.4	10.4	11.9	13.3	<0.0001
Physical exercise (% inactive)	29.9	29.5	30.7	36.6	39.9	<0.0001
Fruit and vegetables (mean g/day)	461	453	434	416	398	<0.0001
Fibre (mean g/day)	18.3	18.2	17.9	17.6	17.1	<0.0001

Measures obtained from the FFQ are additionally adjusted for total energy intake, height, and weight.
FFQ, food frequency questionnaire; SOC, sense of coherence.

independent of age, social class, and education level (and—for variables derived from the FFQ—of height, weight, and total energy intake). After adjustments, no associations were observed between SOC and saturated fat, sugar, or sodium intake. For men and women combined (and with adjustment for age, sex, social class, and education), compared to participants with a weak SOC those with a strong SOC were 17% less likely to be current smokers (odds ratio (OR) = 0.83 (95% CI, 0.76 to 0.92), 18% less likely to be physically inactive (OR = 0.82 (0.77 to 0.88)), reportedly consumed on average 31.3 g/day more fruit and vegetables (95% CI, 23.9 to 38.7), 0.54 g/day more fibre (0.37 to 0.71), and 0.84 more units of alcohol per week (0.49 to 1.18).

Table 2 reveals evidence of dose–response associations (after adjustment for age, sex, social class, and education) with progressively higher percentages of participants reporting that they were current cigarette smokers or that they were physically inactive according to increasingly weak SOC. In addition, participants with increasingly weak SOC reported progressively lower intakes of fruit, vegetables, and fibre. Compared with participants with the weakest SOC (scale score 4 to 6), those with the strongest SOC (score 0) were 28% less likely to be current smokers (OR = 0.72 (95% CI, 0.58 to 0.89), 36% less likely to be physically inactive (OR = 0.64 (0.55 to 0.75)), reportedly consumed on average 63.2 g/day more fruit and vegetables (95% CI, 46.2 to 80.2), and 1.16 g/day more fibre (0.76 to 1.56). From the same model, compared to participants in social class V (n = 639), those in social class I (n = 1271) were less than half as likely to smoke (OR = 0.43 (95% CI, (0.31 to 0.59)), 15% less likely to be physically inactive (OR = 0.85 (0.68 to 1.06)), and consumed 44.8 g/day more fruit and vegetables (95% CI, 20.1 to 69.6), and 0.92 g/day more fibre (0.35 to 1.50). Compared with participants who had no qualifications (n = 7125), those who were educated to degree level (n = 2421) were 40% less likely to smoke (OR = 0.60 (95% CI, 0.50 to 0.73)), 30% less likely to be physically inactive (OR = 0.69 (0.60 to 0.78)), and reportedly consumed 35.0 g/day more fruit and vegetables (95% CI, 22.3 to 47.8), and 0.85 g/day more fibre (0.56 to 1.15).

Figure 1 shows the dose–response associations between SOC and smoking, physical exercise, fruit and vegetable intake, and fibre intake, stratified according to social class and education. Lower social class and lower level of education were each associated with higher levels of smoking and a lower consumption of fruit, vegetables, and fibre. Participants who were both of lower social class and who were less educated were most likely to smoke and had the lowest fruit and vegetable intake. While participants of higher social class were more likely to be physically inactive than those of lower social class, those who were more educated were less likely to be physically inactive than those who were less educated. Importantly, within strata of social class and education the pattern of results was broadly consistent, whereby individuals with progressively stronger SOC reported that they smoked less, were more physically active, and consumed more fruit, vegetables and fibre.

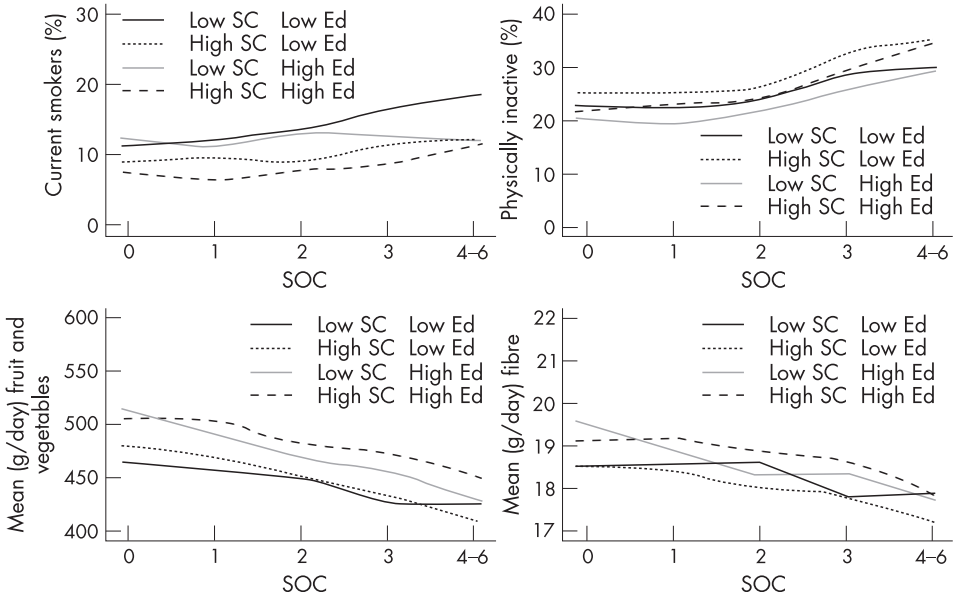

Figure 1 Dose–response associations between sense of coherence (SOC) (0 = strong, 4–6 = weak) and health behaviours (current cigarette smoking, physical inactivity, fruit and vegetable consumption, and fibre intake), adjusted for age and sex (and energy intake, height, and weight for dietary variables), and stratified according to both social class (SC) and education (low social class and low education, n = 4575), high social class and low education, n = 4750), low social class and high education, n = 2455), and high social class and high education, n = 6120).

DISCUSSION

Statement of principal findings

With adjustment for age, social class, and education, participants with a strong SOC were less likely to be current smokers, less likely to be physically inactive, and reported eating more fruit, vegetables, and fibre, though they consumed more alcohol, than those with a weak SOC. Classified within social class and education strata, consistent dose–response associations were observed, such that participants with progressively stronger SOC reported that they smoked less, were more physically active, and had higher intakes of fruit, vegetables, and fibre. The magnitude of these associations, across the full range of SOC scale scores, was such that participants with the strongest (as compared with the weakest) SOC were nearly 30% less likely to be current smokers, 35% less likely to be physically inactive, and reportedly consumed over 60 g/day more fruit and vegetables, and over 1 g/day more fibre, after adjusting for age, social class, and education. For physical inactivity, and intakes of fruit, vegetables, and fibre, these differences were larger than those observed between the extremes of the social class distribution (class I *v* class V) and the extremes of education (educated to degree level *v* having no qualifications).

Strengths and weaknesses of the study

The strengths of the current study are the cohort size (with a sample of over 18 000 participants who had completed a psychosocial assessment and who did not have a pre-existing chronic health condition), the comprehensive range of assessments available, including established health behaviour risk factors for cardiovascular disease and cancer (namely cigarette smoking, physical exercise, diet, and alcohol consumption), and measures of social class and education. However, the study has a number of potential limitations that may restrict the generalisability of findings.

First, around 45% of eligible participants were recruited into the study (owing to the commitment to extended follow up and requests for detailed biological and dietary data) and the study cohort therefore does not represent a truly random sample of the population. Though the EPIC-Norfolk cohort includes fewer current smokers, it is representative of the general resident population of England in terms of anthropometric variables, blood pressure, serum lipids,[17] and physical and mental functional health,[30] and it includes participants with a broad range of socioeconomic circumstances.[31]

Second, analysis relies on a single three-item assessment of SOC, operationalised by Antonovsky initially as a 29-item questionnaire,[3] and included here in preference to longer versions because of space limitations (as the HLEQ assessed a broad range of social and psychosocial factors[32 33]). Satisfactory short term test–retest reliability and validity have been reported for this measure[29] though internal consistency is not as good as for the original scale (see Eriksson and Lindström[34] for a review of the validity of available SOC scales).

Third, the analysis was cross sectional. While in a cross sectional analysis it is possible that lifestyle such as a particular dietary pattern or not smoking could influence SOC, this is less plausible than the reverse association. In addition, SOC may influence reporting rather than actual health behaviours, though this is also less plausible given the opposite relation observed for alcohol compared with smoking, physical activity, and consumption of fruit, vegetables, and fibre.

Fourth, measures are potentially subject to error. Assessment of social class and education may have resulted in residual confounding, and the FFQ is known to be associated with measurement errors whereby, for example, fruit and vegetable consumption is overestimated, although some of this error is controlled through adjustment for height, weight, and total energy consumption. In addition, total salt (sodium) intake is not measured and only non-discretionary sources in foods can be measured.[27] SOC was assessed as part of the psychosocial questionnaire that was administered independently of both the food frequency questionnaire and the EPIC baseline questionnaire (which included social class, education, physical activity, and cigarette smoking). Errors in measuring health behaviours are therefore likely to be non-differential with respect to SOC, which would tend to attenuate the associations observed.[35]

Finally, we have related SOC to reported healthy eating behaviours; food choices are governed by preference and availability of foods as well as by their potential for health benefits.

Strengths and weaknesses in relation to other studies

While two studies of SOC and health behaviour have adjusted for education,[14 16] only one study—showing that SOC is associated with cigarette smoking—has taken account of social class.[15] Our findings from a general population study of 18 287 adults are consistent with the results of a previous study in relation to physical exercise in a smaller population study of 3403 adults,[12] and in relation to cigarette smoking in a study of 3438 adolescents.[15] A further study of 287 health care students reported an association between SOC and physical exercise but not for cigarette smoking or alcohol consumption.[13] A study of 4991 Swedish adults found that saturated fat, sugar, fruit, and vegetables were associated with SOC in women and that saturated fat, fibre, alcohol, fruit, and vegetables were associated with SOC in men.[16] In the current study we found associations for fruit, vegetable, and fibre intake in both men and in women but no associations for saturated fat or sugar, after adjustment for social class and education. In addition, and in agreement with the Swedish study,[16] further work reported that a strong SOC was associated with reduced rates of alcohol problems.[14] In the current study we found the inverse, such that participants with strong SOC reported that they drank more alcohol. However, this could reflect the fact that participants in the EPIC-Norfolk study—consistent with regional statistics for East Anglia[36]—reported modest levels of alcohol consumption compared with the UK average.[27] In addition, a study of 1395 young Canadian adults found no association between SOC and physical activity, cigarette smoking, or heavy drinking.[37]

Implications for clinicians and policy makers

Considerable variation in health behaviours was observed across the full range of SOC scores in this study. A key concept of SOC and the salutogenic framework relates to an individual's generalised resistance resources. These include cultural stability, social supports, knowledge and intelligence, as well as a preventive health orientation.[3 4] Individuals with a strong SOC may be better able therefore to adopt a healthy lifestyle and, for example, more likely to respond to health related advice. In addition, individuals with a weak SOC may engage in less healthy behaviours—for example cigarette smoking—because they are less able to deal with everyday stress. Based on data

What is already known on this subject

- Poor diet, physical inactivity, cigarette smoking, and excessive alcohol consumption are major causes of morbidity and mortality in the United Kingdom.
- A strong sense of coherence has been associated with better self reported health and with lower rates of coronary heart disease and mortality.

What this paper adds

- A strong sense of coherence is associated with healthier behaviour choices, independently of social class and education.
- For physical inactivity, and fruit and vegetable and fibre consumption, the magnitude of associations across the range of SOC scale scores is greater than those observed between extremes of social class and education.
- Interventions to promote healthier lifestyle choices may benefit from taking account of individual differences in personal characteristics defined by SOC.

from the EPIC-Norfolk cohort, we have previously demonstrated that individuals with a strong SOC report more rapid adaptation to their experience of social adversity than those with a weak SOC, and that both adaptation to stress and SOC are associated with all cause mortality.[19 38] No associations were observed in this study between SOC and salt, saturated fat, or sugar intake. It may be that it is more straightforward, for example, to replace white with wholemeal bread or to eat additional fruit and vegetables than it is to bring about dietary changes in fat, sugar, or salt intake. However, differences in measurement error across food groups and nutrient intakes assessed by the FFQ could also account for this finding.

A cohort study with over 120 000 participants showed that each increase of one portion of fruit or vegetables a day (where a portion is 80 grams) was associated with a 4% reduced risk of coronary heart disease and a 6% reduced risk of stroke over a follow up of up to 14 years.[39 40] The variation in diet and other health behaviours observed in this study according to SOC may therefore aid the design of future intervention studies to promote the adoption of healthier lifestyles and have potential importance for public health.

Unanswered questions and future research

SOC has been shown to be associated with health.[11] The current study shows that health behaviours are a potentially important pathway between SOC and health. These findings are consistent with the SOC research framework that focuses on the effective use of resources available to people and enabling maintenance of good health.[3 4] Though it has been demonstrated that SOC can be improved through intervention, at least over the short term, the long term sustainability of these improvements remains unclear.[4] Subject to replication in different study populations, the results of this study imply that interventions to promote healthier lifestyles may benefit from taking account of those characteristics that define SOC.

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THE JECH GALLERY

Playing it safe

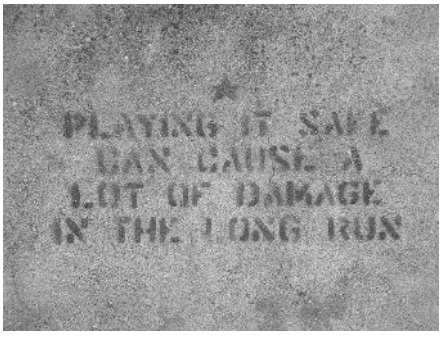

Figure 1 Social comment sprayed on a wall in an inner suburb of Bristol.

Play has physical, social, emotional and cognitive benefits for children.[1] It has been suggested that opportunity for spontaneous play may be all that is needed to increase young children's levels of physical activity,[2] an appealing concept in view of our burgeoning, societal obesity epidemics.

Surveys suggest that the vast majority of children enjoy playing outside and would like to do so more.[3] Yet, from a parental stance, our outdoor urban environments are often ridden with hazards such as stranger-danger, traffic speed, gangs and drugs. These issues affect parental licence on children's mobility and are particularly pronounced in more deprived neighbourhoods.[4 5] Debates around "good parenting" are likely to be further fuelled by media hype, different health-orientated values and bad science.

We stumbled across this social comment sprayed on a wall in an inner suburb of Bristol. Its artist has poignantly captured the risk-orientated conundrum faced by parents today. These few stencilled words summarise the complexities of health advocacy for the public health and child development communities. How can we help parents negotiate these swings and roundabouts of modern life, allow children access to positive risk-taking opportunities and achieve the right balance for their child's optimum health and welfare?

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