Is this the new smoking? An expert panel review of the York University OHV health benefits study

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SUMMARY

Recently, a study by Burr and his associates culminating in three peer reviewed journal articles and a string of press releases emanating from the off-highway vehicle (OHV) industry claimed that increasing riding time on all terrain recreational vehicles (ATVs) and off road motorcycles (ORMs) could meet the basic guidelines of the American College of Sports Medicine and Health Canada for sufficient physical activity leading to positive health adaptations. Should this be true, this study could revolutionize the way that health professionals prescribe physical activity. To examine the efficacy of these claims, the authors convened an expert panel to examine these publications to particularly focus on the problem conceptualization, the research methodology including sample selection and controls, the presentation and interpretation of results and the veracity of their conclusions. The experts concluded, while never questioning the laboratory and field measurements, that there were a number of conceptual, methodological and interpretive limitations and errors that rendered the claims of health benefits indefensible. Furthermore, the researchers largely failed to take account of the healthcare costs associated with riding OHVs which according to the epidemiology literature, and particularly for ATVs, are considerable.

Key words: safety promotion; evidence-based health promotion; physical activity; recreation

INTRODUCTION

Recently, three articles based on research conducted at York University (Toronto) concerning the claimed health benefits of driving all terrain vehicles (ATVs) and off-highway motor (ORM) cycle vehicles have appeared in the scientific literature. Press releases from this study’s main sponsor, the Canadian Off-Highway Vehicles Distributors Council (COHV), have also been distributed widely throughout North America. They suggest, based on this research, that an effective way to improve physical and psychological health is to increase recreational off-highway vehicle (OHV) riding time. Given the ground-breaking implications to health promotion and considering the known healthcare, environmental, social and economic costs particularly associated with driving ATVs, this health promotion assertion warranted careful scrutiny.

To begin, it should be noted that the documented health costs and environmental impacts of driving recreational OHVs are considerable. In the USA, for example, the healthcare costs associated with ATVing alone have been estimated to be $3.24 billion annually by the Centers for Disease Control and Prevention (Helmkamp and Lawrence, 2007). In Canada, the combined healthcare burden of ATVing and
Snowmobiling was calculated to be $381 million in 2004 (SMARTRISK, 2009). The SmartRisk report notes that these activities ‘accounted for a significant portion of transport related injuries and related hospitalizations (13%), emergency room visits (7%), and cases of permanent partial disability (12%) and permanent total disability (11%)’ [(SMARTRISK, 2009), p. 24]. Landscape damage associated with ATVing is also extensive (Wuerthner, 2007) and atmospheric pollution is substantial (U.S. Environmental Protection Agency, 2002). While Wuerthner documented with photographic evidence and text the extensive landscape damage attributed to OHVs in North America, to date no attempt has been made to calculate the true restoration costs. The Halifax Regional Municipality in Nova Scotia have nevertheless estimated the extra costs of maintenance when trails are used by OHVs noting that they are typically three to four times that of active transportation (AT) only trails (Euloth, 2009). Significantly, the US Environmental Protection Agency estimated that the average two-stroke ATV created 36 times the hourly operating pollution of a typical automobile, while a two-stroke off road motorcycle develops over 30 times that level. Incredibly, two-stroke snowmobiles pollute at 96 times the level of an average automobile. While four-stroke engines are better, even the best class of OHV vehicles, four-stroke ATVs, were about 18 times worse than cars (USEPA, 2001).

Beyond the health and environmental impacts, there is also an emerging literature on the social (Bissix and Medicraft, 2009; Pitter, 2009) and economic costs of ATVing (Power, 2007; Jannmaat and Vanblarcom, 2009) and when healthcare costs are also factored in, claims of economic benefits appear unfounded. Pitter, for example, examines the ‘growing conflict over land use that has drawn public attention to recreational sport, health, and environmental policy at the local and provincial levels’ focussing particularly on recreational OHVing, while Bissix and Medicraft compared the benefits and costs of ATVing and AT. Importantly, Power provides a critique of the industry’s propensity to equate gross economic activity with public benefits noting that

The motorized recreation industry and user groups seek maximum access to the public domain with minimal restrictions on their activities. That industry has often tried to use economic analysis to demonstrate the social rationality of leaving motorized recreation largely unregulated. These analyses, however, are based on a peculiar economic alchemy that seeks to transform private interests and public costs into public benefits (Power, 2009).

Given this backdrop to OHVing and the likely controversy of suggesting OHVing as a therapy for averting sedentary living, it is surprising that the researchers at York University and the Nova Scotia Department of Health Promotion and Protection, a co-funding agency, did not veto industry press releases. The York University research team was in fact cited as co-contacts to the industry press releases (Farquhar, n.d., b). The initial press release by the OHV industry referring to the article in the academic journal, Medicine and Science in Sports and Exercise (MSSE) (Burr et al., 2010a) states for example,

On the basis of the measured metabolic demands, evidence of muscular strength requirements, and the associated caloric expenditures with off-road vehicle riding, this alternative form of activity conforms to the recommended physical activity guidelines and can be effective for achieving beneficial changes in health and fitness.

Jamie Burr added further that “Off-Road Vehicle (ORV) riding is similar in aerobic demand to many other recreational, self-paced, sporting activities such as golf, rock climbing and alpine skiing” (Farquhar, n.d., b).

Given the re-appraisal by an expert panel, reported here, of the evidence presented by Burr et al. in their three articles (Burr et al., 2010a, b, c), it is argued here that no training effect from OHVing can be claimed because of methodological limitations, including weak study controls, and inappropriate data extrapolations and interpretations. While the researchers acknowledged some methodological limitations, they nevertheless made a number of speculative interpretations that were seized upon by the study’s main sponsor, COHV, in a series of press releases that have been distributed widely including by the Reuters Press Agency (Reuters, February 2011). They have been uncritically quoted in a number of professional newsletters, media reports and OHV user publications throughout North America.
If the claims of health benefits could be substantiated, this would have far reaching implications for health promotion through physical activity. It should be noted that ATVing is one of the fastest growing recreational activities in North America, where it is estimated that there are over 10 million ATVs in use in the USA alone, and this activity is growing fast in Europe and around the world. ATVing is also the subject of numerous health and safety warnings, frequent legal and political controversies, and is implicated with widespread environmental damage. Despite the evidence of health risks and environmental damage, the OHV industry aggressively promotes this activity and now uses the York University study to help legitimize its industry. Consequently, any claim that OHVing has health promotion benefits, legitimized by peer reviewed scientific publications, must be carefully scrutinized.

METHODS

A panel of experts was recruited in December 2010 to review the York University Study. The contributors were experts in exercise sciences and medicine. Four have PhDs in exercise physiology while the fifth PhD’s expertise is in the psychological aspects of kinesiology. The two contributing physicians have expertise in sport and environmental medicine. Two complementary strategies were used. All panel members carefully assessed the articles and press releases; five participated in a focus group and two submitted comments using e-mail. The instructions in Table 1 were offered to guide but not limit expert assessment. Panelists were provided with various manuscript iterations to ensure their assessments were accurately represented.

Table 2 provides a glossary of terms useful in interpreting the arguments presented in this review.

Table 2: A glossary of technical terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Aerobic fitness</td>
<td>The ability to sustain physical work for long periods</td>
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<tr>
<td>Aerobic power</td>
<td>The amount of physical work a person is able to accomplish determined by the rate that oxygen is utilized</td>
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<tr>
<td>Body composition</td>
<td>The ratio of body fat and fat-free mass. A higher proportion of fat-free mass indicates a healthier body composition</td>
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<td>Blood lipids</td>
<td>Fat in the blood including fatty acids and cholesterol</td>
</tr>
<tr>
<td>BMI (body mass index)</td>
<td>A weight-to-height ratio calculated by dividing weight in kilograms by the square of height in meters. It is an indicator of normal weight or over or underweight</td>
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<tr>
<td>Cardiovascular demand</td>
<td>The oxygen delivery mechanism requirements to maintain a physical activity</td>
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<td>Health protective effect</td>
<td>That which maintains or enhances health</td>
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<tr>
<td>FITT training principle</td>
<td>The frequency, intensity, type and length of time of a physical training activity</td>
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<tr>
<td>Isometric contractions</td>
<td>Involves muscular contractions against resistance without a change in length of the muscle or joint movement</td>
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<tr>
<td>MET (metabolic equivalent of task)</td>
<td>The energy cost of physical activities measured as multiples of the resting metabolic rate</td>
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<tr>
<td>Metabolic syndrome</td>
<td>A combination of medical, physical and physiological conditions that together increase the risk of developing cardiovascular disease and diabetes</td>
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<tr>
<td>SF-36 assessment tool</td>
<td>A questionnaire that measures quality of life from a respondent’s point of view. It has both a physical component (PCS) and a mental component (MCS)</td>
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<tr>
<td>VO₂</td>
<td>The volume of oxygen used for any given state such as resting or moderate exercise</td>
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<tr>
<td>VO₂max</td>
<td>The maximal oxygen uptake possible by an individual. This indicates a person’s level of aerobic fitness</td>
</tr>
<tr>
<td>VO₂R</td>
<td>VO₂R or VO₂ reserve is the difference between VO₂max and resting VO₂ consumption</td>
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OVERVIEW OF THE CLAIMED YORK UNIVERSITY RESULTS

The main health benefit claims made by Burr and his associates at York University are summarized in Table 3 and where appropriate compared to the physical activity guidelines produced by the American College of Sport Medicine and Health Canada. The first article published in the MSSE journal (Burr et al., 2010a) concludes that ‘on the basis of metabolic demands, evidence of muscular strength requirements, and the associated caloric expenditure with off road riding, this alternative form of activity conforms to the recommended physical activity guidelines and can be effective for achieving beneficial changes in health and fitness’.

The second article published in JSS was a cross-sectional examination of the physical fitness and selected health attributes of users (Burr et al., 2010b). It claims that ORM riders had aerobic fitness at the 79th percentile, while ATVers averaged at the 40th percentile compared to national norms and together had a low incidence of metabolic syndrome (12.9%). ORM riders had healthier body composition fitness than ATV riders, but were no healthier than that of the general population.

In the third article published in the HFJC relating to quality of life, off road riders were said to ‘have high levels of mental and physical functioning QOL [quality of life]’ (Burr et al., 2010c). And ‘given their higher physical function, [ORM] riders are less likely than [ATV] riders or the general population to have physical limitations or health problems’.

A press release (Farquhar, n.d., a) claimed that

- ‘Off-road vehicle riding was found to require “a true physiological demand that would be expected to have a beneficial effect on health and fitness according to Canada’s current physical activity recommendations”’.
- ‘Off-road vehicle riding was determined to be a recreational activity associated with moderate-intensity cardiovascular demand and fatigue-inducing muscular strength challenges’.
- ‘Oxygen consumption, which is an indicator of physical work, increased by 3.5 and 6 times the resting values for ATV and ORM riding respectively – which falls within the moderate intensity activity according to the American College of Sports Medicine guidelines and is in line with Canadian physical activity recommendations’.
- ‘The duration of a typical ride (2–3 h for ATV, 1–2 h for ORM) and the frequency of the rides (1–2 times a week) create sufficient opportunity to stimulate changes in aerobic fitness which falls within the physical activity guidelines (American College of Sports Medicine recommends between 450–720 MET minutes per week)’ (Burr et al., 2010a).

Controversially, given the associated trauma costs of ATVing noted above, a press release proclaims that

- ‘More health and fitness benefits could likely be realized if the frequency of riding were increased to a level compatible with the recommended Canadian guideline for physical activity’ (Farquhar, n.d., b).
- ‘Using heart rate measurements alone, the demands of riding belong to the category of “hard” exercise [however,] – this increase of intensity may be linked to heightened psycho emotional responses (i.e. adrenalin), an effect of heat stress while riding, or a response to repeated isometric squeezing of the handlebars... When considering muscular force and power involvement, study results indicate a greater impact on muscular endurance as opposed to an increase in strength’.
- ‘Off-road vehicle riders perform considerable physical work using their arms and upper body’.
- ‘This upper body strength requirement “could lead to beneficial training increases in musculoskeletal fitness”’.
- ‘Study findings also picked up on the psycho-social effects of riding – the “enhanced quality of life and stress reduction effects of off-road riding”’.
- ‘Findings also reflect the “importance of alternative physical activity such as off-road riding to promote physical activity in a group who might otherwise forego exercise altogether (habitual ATV riders in the study were not avid exercisers) and all physical activity is beneficial”’ (Farquhar, n.d., a).

DISCUSSION AND COUNTER POINTS

While the York University study is the first in this area, there are several shortcomings that
### Table 3: A comparison of physical activity guidelines with study claims and interpretation errors

<table>
<thead>
<tr>
<th>Topic</th>
<th>Study claims and/or omissions</th>
<th>Industry press release claims or omissions</th>
<th>ACSM guidelines for all healthy adults 18–65 years</th>
<th>Health Canada guidelines for adults 18–64</th>
<th>Expert panel comments</th>
</tr>
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<tbody>
<tr>
<td>Aerobic demand and health benefits in field testing</td>
<td>Claimed that participants could meet ACSM &amp; Health Canada guidelines when activity levels were extrapolated to 2 h for ORM and 3 h for ATV riders. <em>Burr et al., 2010b</em>, p. 9. This contradicts their statement that ‘This lack of a relationship suggests that recreational off-road riding as undertaken by the average habitual participant does not provide a sufficient physical activity dose to achieve improvements in aerobic fitness <em>(Burr et al., 2010b, pp. 9–10)</em>.</td>
<td>‘Oxygen consumption, which is an indicator of physical work, increased by 3.5 and 6 times the resting values for ATV and ORM riding respectively. According to the ACSM these results fall within moderate intensity activity guidelines and are in line with Canadian physical activity recommendations’. <em>(COHV Press Release - ATV &amp; ORM Health Benefit Study Fact Sheet.)</em></td>
<td>‘…moderate intensity aerobic physical activity or a minimum of 30 min on five days each week or vigorous-intensity aerobic activity for a minimum of 20 min on three days each week….can be accumulated toward the 30-min minimum from bouts lasting 10 or more minutes’</td>
<td>‘Be active at least 2.5 h a week to achieve health benefits’</td>
<td>The researchers failed to acknowledge that according to ACSM &amp; Health Canada Guidelines moderate intensity activity must be maintained for a minimum of 10 min. ORM &amp; ATV riders reached moderate intensity activity for only 38 and 14% of an average 24 min duration test ride. Given the likelihood that this peak intensity is unevenly spread throughout the ride, the duration of moderate intensity activity does not meet Health Canada or ACSM guidelines</td>
</tr>
<tr>
<td>Muscular strength and endurance</td>
<td>The older off-road riders in this study had lower mean levels of adiposity and increased strength and power compared with population norms. It is impossible to determine whether this difference from ‘normal’ ageing reflects a beneficial effect of participation in off-road riding or if other biasing factors are influencing the results, thus further investigation is warranted.</td>
<td>‘When considering muscular force and power involvement, study results indicate a greater impact on muscular endurance as opposed to an increase in strength <em>(NB: this is in reference to hand grip specifically)</em>’</td>
<td>It is recommended that 8–10 exercises be performed on two or more non-consecutive days each week using major muscles. A resistance (weight) should be used that results in substantial fatigue after 8–12 repetitions of each exercise</td>
<td>Get stronger by adding activities that target your muscles and bones at least two days per week</td>
<td>There is no specific targeting or overloading of the muscles sufficient to cause positive physiological adaptation, as prescribed by ACSM guidelines. Despite this, reference to Burr et al.’s Table 4 and this critique’s Table 4 indicates that the ATV male participants were said to be above norms in the push and pull test. However, no recognized national norms exist for this test. Regardless no scientific basis for a cause and effect relationship was demonstrated</td>
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invalidates many of the assertions claimed and particularly those disseminated through industry press releases. Interestingly, the researchers claim that they avoided selection bias [(Burr et al., 2010a), p. 2]; however, this is difficult to imagine given the participant recruitment process and the initial fitness assessment of participants. Shaw Consultants conducted a ‘national fitness survey’ to launch the research process using the following to recruit participants. ‘WHY? To offset the perception that motorized recreation produces little-or-no health benefit. AND... when we promote our sport, we can promote the health benefits as well!!’ (Shaw Consulting, 2007). York University Study participants were recruited initially by the OHV industry through clubs in Ontario and Quebec and in doing so made its purpose clear:

The COHV and its member companies...are committed to family recreation and healthy, active lifestyles. We believe that once concluded the results of this study will be a great opportunity for OHV recreational riders to prove [emphasis added] that being out on the trails is not only fun but contributes to individual and family well-being and physical fitness [(Farquhar, n.d., c) p.1].

The general thrust of this remit was later confirmed by the lead researcher in an interview with CBC Radio (White, 2010) which was ‘to prove’ that OHVing contributed ‘to individual and family well-being and physical fitness’.

Even if participants had been recruited at arms length, participant bias remains problematic. Two closely related conditions of bias are recognized in the epidemiology literature; they are the ‘healthy worker’ and ‘healthy user’ effects (Li and Sung, 1999). Li and Sung suggest that volunteers are often healthier and more concerned about their health than any general cohort. While self-selection in OHVing largely deters clinically unfit users, such unfit individuals are nevertheless included in population norms. Given this phenomenon, higher group scores in a voluntary sample cannot be directly attributed to riding an OHV based in comparison with population norms but is more likely the result of the healthy user effect. The healthy participant phenomenon suggests that those who ride OHVs but perceive their physical condition to be poor are unlikely to volunteer, particularly given the well advertised study goals.

Added to this was that many of the initial participants opted out of the physiological tests and the researchers eliminated those on medication. Volunteers were also well aware of the study aims and the researchers admit that ‘those who deemed their personal fitness to be sub-par may have self-selected out of the study’ [(Burr et al., 2010b), pp. 9–10]. While selection bias was acknowledged in this second article population norms were still offered in place of a study control; however, the inherent bias initially acknowledged by the research team was completely ignored in industry press releases. It is argued here that if population norms are to be used at all as a proxy for a study control, a more defensible approach to demonstrate fitness benefits is to compare OHV participants with reasonably healthy and active individuals and not with a predominantly sedentary national population. A study of the economic burden of inactivity by Gledhill and associates (Katzmarzyk et al., 2000) noted at that time that 65% of the Canadian adult population was inactive. While studies in the intervening years using self-reported data have suggested higher levels of activity among Canadians, a recent study using accelerometers point to a much lower cohort, only 15% reaping possible health benefits from activity (Colley et al., 2011).

Looking more closely at this study other issues emerge. A rather unsettling foundation to the Medicine and Science in Sport and Exercise (MSSE) article (Burr et al., 2010a) is the reference to unpublished observations. It is assumed that these results are now published in the two subsequent articles critiqued here (Burr et al., 2010b,c). The MSSE article suggests that ‘examination of the physiological and psychological characteristics of recreational off-road vehicle riders have some health, fitness, and quality-of-life advantages over the normative population’; however, the higher scores attributed to OHV participants in the MSSE article are never sufficiently linked to OHV riding to make this claim, nor as will be argued below do the study results suggest health and fitness advantages over the normative population.

The researchers in the Journal of Sport Sciences (JSS) article conclude that ‘our results show that the habitual recreational riders of off road vehicles in the present study collectively have physiological profiles that are slightly healthier than that of the general population’ [(Burr et al., 2010b), p. 7]. Given the healthy
rider effect noted above, this should be expected but not as a result of driving an OHV. On closer examination of a table entitled ‘Summary of fitness and health of habitual recreational off-road vehicle riders by gender and vehicle type’ [(Burr et al., 2010b), Table 4, p. 7] from which the researchers glean their conclusion, the data inferences are actually different (See our Table 4). The results for ATV riders are comparatively worse while somewhat inconclusive for ORM study participants. With male ATV riders, of the 13 fitness and health measures, 7 measures are in fact inferior to norms and clinical measures; 5 are on a par and 1 above norms (using age-differentiated measures, one neutral measurement is replaced by a positive one). As the researchers provide no algorithm to suggest these measures should be weighted, it is not possible to conclude from their results that ATVers are fitter than the general population. They are in fact at or below the vast majority of health and fitness norms despite a reasonable expectation, based on the healthy user bias that they ought to be better. In addition, as one panel expert noted:

The riders…reported that they participate in a variety of other activities (sports, work, fitness activities, etc) 3 or 4 times per week. Given that these other weekly activities are likely to generate health benefits - providing the intensity and duration to meet the accepted FITT thresholds - the off-road recreational activities simply can’t be proven to be the source of any of the reported health and fitness effects.

The most fundamental error in the MSSE article (Burr et al., 2010a) is that the researchers assert that ‘the metabolic demand of off-road riding is at an intensity level associated with health and fitness benefits’ in accord with Health Canada and the ACSM guidelines. This is not the case as these guidelines clearly indicate that a minimum bout of 10 min is necessary (Table 3) and their research indicates that the maximum possible duration of aerobic activity was on average 3.36 min for ATV riders and 9.12 for ORMers. This also assumes that this moderate intensity activity took place in a continuous block which in practice is impossible. Yet another problem exists in measuring aerobic power. The researchers tested a subsample (n = 98) to measure aerobic power in the laboratory; however, 43 others did not participate. While no systematic difference was claimed, their rationale apparently had nothing to do with measuring aerobic power and consequently they could not eliminate the possibility that some did not participate to avoid skewing the results downwards. While this does not invalidate the test results; it does limit generalizability.

On the surface, the researchers seem to satisfactorily account for ‘a disproportionate increase in HR [heart rate] compared with objectively measured VO2 while riding’ by suggesting that this could be the result of isometric contractions and socioemotional responses. Significantly, the MSSE article (Burr et al., 2010a) does provide evidence of elevated but quite modest metabolic demand, but given the health and environmental costs of ATVing we do not believe these are sufficient to justify ATVing as a legitimate PA prescription (Table 3). ATV riders were measured on average to be 3.5 METs for 14% of their short duration test ride which for brief periods is just above the light intensity exercise level but ‘less taxing than slow walking’ (p. 1349). While the energy expenditure is more than lying on a couch or sitting at a desk, it is insufficient to provide a physical training or health maintenance effect. The researchers seem to concur as they note that ‘the typical pattern of long-duration and infrequent bouts reported by habitual riders may be less effective considering the ACSM’s statement that aerobic endurance training [of less than twice a week at less than 40–50% of VO2R], generally does not provide sufficient stimulus for maintaining fitness in healthy adults’ (p. 1352). The evidence for ORM riders is more favourable, but we do not believe it is enough to counteract this activity’s associated health risks.

Curiously, the researchers suggest that if riding was performed 5 days a week for durations of at least 30 min that would meet ACSM’s guidelines, but they fail to explain why and do not acknowledge that the moderate activity was never sustained for the necessary minimum. They nevertheless speculate by extrapolating the test ride to 2 h for ORMers or 3 h for ATVers that ‘infrequent longer bouts of PA, summing to the same absolute weekly expenditure, leads to the same health benefits as shorter duration, frequent exercise’ (p. 1352). According to ACSM guidelines, this speculation is unjustified (Table 3).
Table 4: Reinterpretation of fitness and health measures according to gender and vehicle type

<table>
<thead>
<tr>
<th>Fitness measures</th>
<th>Anthropometric and clinical measures</th>
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<tr>
<td></td>
<td>Participation in PA</td>
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<tr>
<td></td>
<td>General Age Δ</td>
</tr>
<tr>
<td>ORMM</td>
<td>Neg</td>
</tr>
<tr>
<td>ORMF</td>
<td>Neg</td>
</tr>
<tr>
<td>ATVM</td>
<td>Neg</td>
</tr>
<tr>
<td>ATVF</td>
<td>Neg</td>
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There are 13 basic fitness and health measurements represented in the table. Neg (abrev. for negative) = less healthy that the mean norm; Pos (abrev. for positive) = healthier than the mean norm; neutral = statistically equivalent to norm; and 0 = no group determination made.

ORMM, male off road motorcycle riders; ORMF, female off road motorcycle riders; ATVM, male ATV riders; ATVF, female ATV riders. WC, waist circumference; BP, blood pressure. Metabolic syndrome refers to the prevalence of physiological conditions that increase the risk of cardiovascular disease and diabetes.

Applying the general measurements for ORM males, there is one positive measure, four negative and seven neutral measures. Metabolic syndrome was not noted in the original table for ORM riders.

Applying the age-differentiated measurements for ORM males, there are four positive measures, four negative, four neutral measures. Metabolic syndrome was not noted in the original table for ORM riders.

Applying the general measurements for ATV Males, there is one positive measure, seven negative and five neutral measures.

Applying the age-differentiated measurements for ATV males, there are two positive measures, seven negative and four neutral measures.

There are too many missing values to reasonably categorize female ORM or ATV riders.

Adapted from Table 4, Burr et al. (2010b) to indicate positive, negative and neutral comparisons with norms.
In regards to strength and endurance, the conclusions drawn appear at best confusing and likely factually wrong. The researchers state, for example, that ‘unexpectedly, we observed an increase in ATV grip strength from before to after the ride, potentially explainable as a stimulatory effect of riding’ ([Burr et al., 2010a], p. 1352). This stimulatory effect suggests, however, that because there was no loss of strength, then no appreciable work was performed and no appreciable muscular training effect could be expected (Table 3). The researchers noted that ‘comparing the grip strength of habitual recreational off-road riders to the normative Canadian population in which there were no improvement[s] in strength (except in older riders), it seems that off road riding affects muscular endurance more so than strength’ (p. 1353). It is odd that they present data that on the one hand clearly show no fatigue in arm strength after a test run and indicate that there is no improvement in strength in laboratory assessments, but claim in a press release that there is indeed evidence of muscular strength requirements. One can of course argue that any body movement requires some level of strength but such a claim has no fitness prescription merit.

One point concerning the QOL article (Burr et al., 2010c) is that the SF-36 is a common psychological health assessment tool typically used in clinical situations to assess changes over time. As such, it is unlikely sufficiently sensitive to measure subtle changes in psychological health of generally healthy individuals. To validly compare with SF-36 norms, the researchers needed to randomly select from the full spectrum of habitual OHV users, including those temporarily or permanently incapacitated. Interestingly, the researchers suggest limited ability to claim a cause and effect relationship using this instrument, but this caution was abandoned in industry press releases. Given these limitations, we argue that there is no basis to claim that recreational OHVing improves psychological health (Hemingway et al., 1997; Hopman et al., 2000).

**SUMMARY AND CONCLUSIONS**

While the researchers must be commended for taking on such a difficult and controversial PA study, they have unnecessarily exposed themselves to censure by making an array of unsubstantiated speculations and indefensible assertions that have been taken out of context in industry press releases and repeated widely and uncritically throughout North America. Given the flaws identified, it appears that they attempted to justify the original study aims and satisfy the original remit of ‘proving’ that these activities provide legitimate, health inducing physical activity. In all three articles, the researchers seem to move from scientifically credible measurements to unsubstantiated speculations concerning their significance.

From the expert panel’s perspective, this research provides an interesting documentation of an array of physical health attributes but demonstrates no cause and effect relationship justifying a claim that riding OHVs is an effective PA health promotion modality. What the research showed is that there is a brief elevation of heart rate and oxygen consumption above resting or sitting levels. Even if these briefly elevated levels were determined to be a true physiological response to exercise and not an adrenalin rush, this evidence still fails to demonstrate that either OHV mode produces the necessary exertion that leads to positive health and fitness adaptations. Furthermore, any physical activity with an extremely high risk of morbidity and mortality accompanied by high levels of environmental damage cannot logically or morally be seen as beneficial to users or society. To suggest otherwise, coupled with a failure to warn riders of the associated health risks, is a serious omission. Such failure could result in the uninformed adopting or increasing this recreational activity at great risk to their wellbeing.

Taking into account the documented healthcare costs of ATVing, which are substantial compared to any other recreational activity with the possible exception of snowmobiling (Pierz, 2003), and considering the environmental and atmospheric damage that is extensive and the growing evidence of social disruption, OHVing and particularly ATVing might be more responsibly seen as the new ‘smoking’ by health promotion and protection professionals. Even if the physiological demand of ATVing was substantially higher than that assessed in this study; the
associated morbidity and mortality of ATVing and ORMing, although briefly acknowledged in the JSS article (p. 10) renders this recommendation as tantamount to prescribing expensive drugs with marginal target effectiveness and substantially harmful side effects. It is important to note from a health promotion and protection perspective that the associated danger of driving off-highway motor vehicles was never acknowledged in the MSSE (Burr et al., 2010a) or JFH articles (Burr et al., 2010c). It is inconceivable to imagine that the possible but weak physical activity associated with OHVing could compensate for its inherent, associated healthcare, environmental and social costs. A much more responsible health promotion and environmentally responsible prescription would be, based on this study’s results, for the OHV industry to prescribe garaging the OHV, and substituting an off-highway motor vehicle ride with a 30-min brisk walk or at least a 10-min walk three times a day to meet Health Canada and ACSM guidelines.

Surprisingly, given the researchers initial justification for alternative forms of PA, including that alleged to occur in OHVing, which was to combat sedentary living and the associated healthcare costs from morbidity and mortality [(Burr et al., 2010b), p. 4], the researchers largely ignore the enormous healthcare costs directly resulting from recreational use of ORMs and particularly ATVs. A review of the medical index PubMed using ‘ATV injury’ as the key search word elicits 121 epidemiology articles documenting this activity’s healthcare burden. There are also several health warnings about driving ATVs from such prestigious health organizations as the American Academy of Orthopaedic Surgeons and the Canadian Association of Pediatric Surgeons (2008). Given this evidence, it is highly likely that the potential risks of ATVing on balance is much more likely to shorten rather than lengthen one’s lifespan and more likely to cause rather than reduce morbidity with the associated reduction in quality of life. The one question asked of all the expert panelists and the contributing authors was based on the results of this study and what they know of OHVs health and environmental costs and benefits whether they would prescribe OHVing as a PA modality. The answer was clear: No.

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