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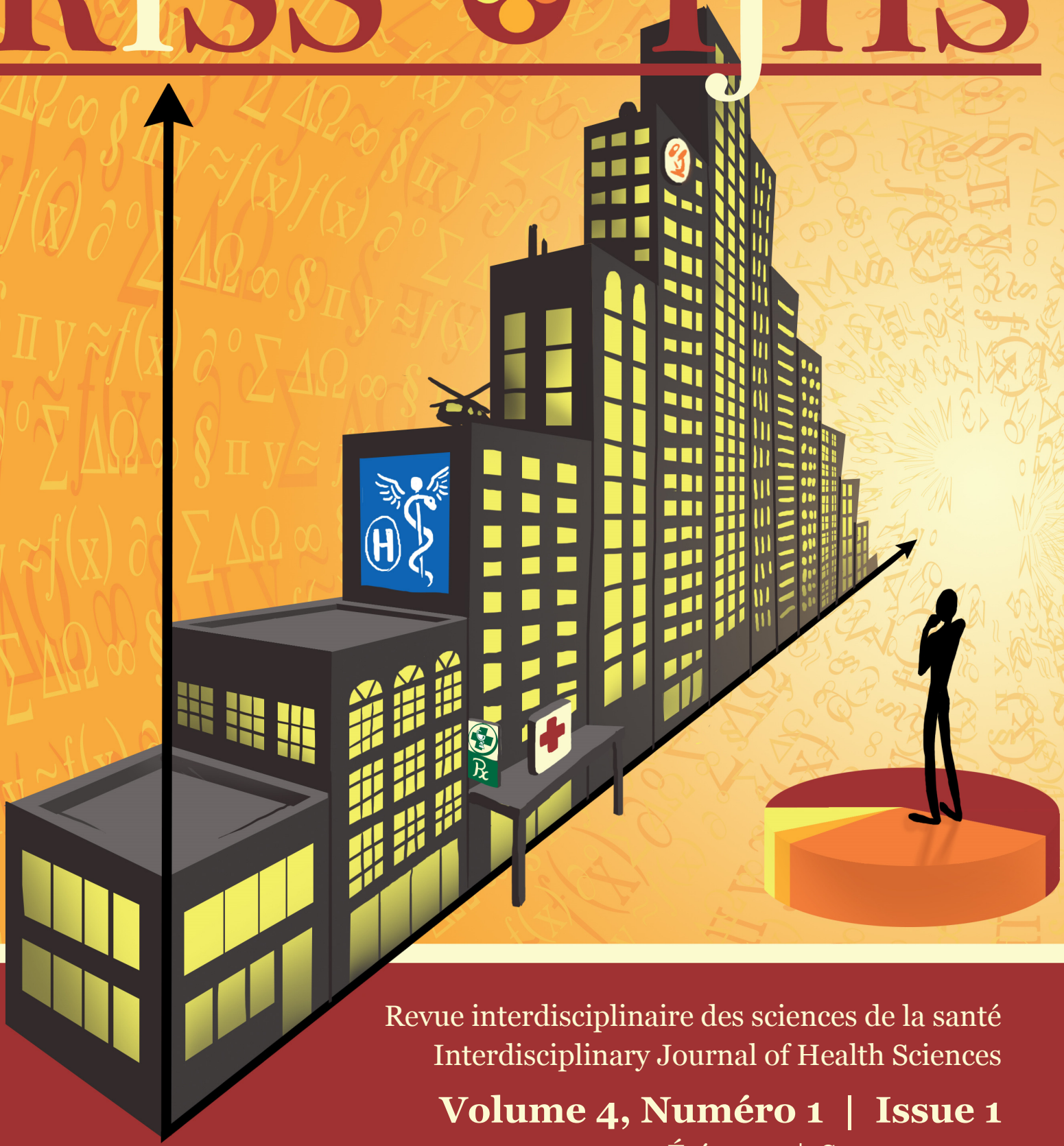

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Avant-propos

Gatien DE BROUCKER Rédacteur en chef

L'étymologie du mot « statistique » remonte au verbe latin « *stare* » (= « se tenir debout »), comme origine lointaine du mot. « *Stare* » a engendré un bon nombre mots en français, parmi lesquels on trouve « l'état » comme dans « l'état de santé » ou « l'état d'une situation ». Ce verbe a aussi donné « l'État » et l'adjectif « étatique », désignant l'institution gouvernementale. Dans le latin tardif, on trouve l'emploi du mot « *statisticum* » pour signifier ce « qui concerne l'État », ce qui a donné le mot actuel « statistique » (Cellard, 1980). Aujourd'hui, les statistiques font intuitivement référence à l'approche quantitative (et positiviste) dans notre quête de savoir scientifique, en comparaison avec les approches qualitatives (et interprétatives ou constructivistes).

À l'ère moderne, l'usage des statistiques s'est largement répandu pour développer notre compréhension de l'univers dans lequel nous vivons, mais aussi pour surveiller les problèmes sociaux et de santé qui affectent les populations humaines (*cf.* Daskalakis, p. 28). Grâce aux nombreuses disciplines construites autour de l'analyse statistique et des mathématiques, d'innombrables entreprises, organisations et institutions ont aujourd'hui recours à la collecte et à l'analyse de données pour définir leur agenda, pour gérer et faire l'évaluation de leurs activités et pour atteindre leurs objectifs. Il paraît donc inéluctable que l'homme moderne ait à se développer un sens aigu de ce que sont les statistiques et de leur utilisation – ce que certains appellent la "littératie statistique".

Nous sommes pourtant loin de dire que l'approche quantitative est le seul moyen efficace de faire de la recherche scientifique : les études qualitatives et l'approche inductive en sciences sociales, comme la théorie ancrée, ont permis aux chercheurs de mettre en lumière pourquoi et comment certaines dynamiques sociales se développent. Une grande partie de ce travail a contribué à l'élaboration des déterminants de la santé utilisés aujourd'hui dans l'élaboration des politiques de santé publique.

Les statistiques restent néanmoins au cœur de la plupart des études biomédicales et dans les sciences car elles véhiculent un sens d'objectivité dans notre observation du monde. Les statistiques sont « neutres » car leur collecte et leur analyse ne doivent théoriquement pas dépendre de la perception de l'observateur : toute personne ayant les mêmes instruments de mesure, sujets aux mêmes conditions environnementales doit trouver des résultats égaux – l'expérience est reproductible. Avec un contrôle approprié des différentes variables (*cf.* de Broucker, p. 12), les analystes sont en mesure de réduire les biais d'interprétation qui pourraient nuire à l'objectivité, et donc à la validité de l'expérience. Pourtant, l'objectivité de l'analyse statistique est toujours discutable (*cf.* Evans, p. 10) et la validité d'une expérience s'appuie toujours fortement sur les compétences de l'analyste.

Ce numéro présente des commentaires signés par des personnalités reconnues du monde des statistiques ainsi que des articles et des essais d'étudiants enthousiastes d'appliquer ce qu'ils ont appris dans leurs cours d'analyse statistique et de méthodes de recherche.

Je tiens à remercier chaleureusement nos contributeurs invités Constantine Daskalakis, Patrice de Broucker, Michael Evans et John Pullinger pour leur soutien à cette initiative étudiante pour engager les étudiants à développer et à partager leurs propres travaux de recherche en sciences de la santé. Je remercie également Katrine Dragan, conceptrice de la page de couverture de ce numéro ; Raywat Deonandan, notre conseiller académique ; tous les étudiants qui ont répondu au défi d'écrire et de soumettre un manuscrit à la révision par les pairs, et l'équipe éditoriale qui, par son travail, contribue directement au développement des étudiants et au progrès du savoir en sciences de la santé.

Foreword

Gatien DE BROUCKER Editor-in-Chief

The etymology of "statistics" points to the Latin verb *stare* (= to stand) as the far origin of the word. In addition to the meaning to stand, *stare* gave a handful of derivative words. More specifically, it gave the words "status", or the "state" of something or someone, and the word "State", which designates the government. In late Latin, the adjective "*statisticum*" was present in the administrative discourse to refer to something "that concerns the State". This latter word gave today's word "statistics" (Cellard, 1980). Statistics now refer intuitively to a quantitative (and positivist) approach to our scientific quest for knowledge, in opposition to a qualitative (and interpretive) approach.

In modern times, statistics became widely used for developing our understanding of the universe in which we live, but also for monitoring health and other social issues that affect human populations (*cf.* Daskalakis, p. 28). Thanks to the many disciplines built using statistical analysis and mathematics, countless industries, organizations and institutions resort nowadays to data collection and analysis to determine their agenda, manage and evaluate their activities, and advance their objectives. It seems, therefore, inevitable for the modern man to develop a keen sense of what statistics are and the basics of its usage or "statistical literacy".

Far from saying that a quantitative approach is the only sound means of scientific investigation, qualitative studies and social science's inductive approach, such as the grounded theory, have enabled researchers to unveil much of why and how social dynamics take place. Much of this work contributed to the development of the determinants of health that we are using today in public health policy-making.

Nevertheless, statistics remain at the heart of most biomedical and science research as they convey a sense of objectivity in our observation of the world. Statistics are considered "neutral" in the sense that their collection and analysis should not depend on the observer's perception: anyone with the same measuring instruments and in the same environmental conditions should find equal results – the experiment is reproducible. With appropriate control variable (*cf.* de Broucker, p. 20), analysts are able to reduce interpretation biases that may impede objectivity and, thus, the validity of the experiment. Yet, the objectivity of statistical analysis is always debatable (*cf.* Evans, p. 10), and the validity of an empirical investigation highly relies on the skills of the analyst.

The present issue features commentaries from key figures of the statistics world as well as articles and essays from students who are enthusiastic to apply what they learned in statistical analysis and research methods courses.

I would like to warmly thank our guest contributors Constantine Daskalakis, Patrice de Broucker, Michael Evans and John Pullinger for their support to this student initiative to engage students in developing and sharing their own research work in health sciences. I would also like to thank Katrine Dragan, the designer of this issue's trendy cover page; Raywat Deonandan, our academic counsellor; all the students who met the challenge of presenting contributions to the peer-review process and the editorial team who, through their hard work, contributed directly to the development of students and the advancement of knowledge in health sciences.

Auteurs invités | Guest Authors

John PULLINGER	Président de la *Royal Statistical Society*, Royaume-Uni
	President of the *Royal Statistical Society*, UK
Michael EVANS	Président de la *Société Statistique du Canada*, Canada Professeur au département des statistiques, *University of Toronto*, Canada
	President of the *Statistical Society of Canada*, Canada Professor at the Department of Statistics, *University of Toronto*, Canada
Patrice DE BROUCKER	Président du Réseau de *l'Organisation de Coopération et de Développement Économique* (OCDE) sur les retombées professionnelles, économiques et sociales de l'apprentissage
	Chair of the *Organisation for Economic Co-operation and Development* (OECD) Network on Labour Market, Economic and Social Outcomes of Learning
Constantine DASKALAKIS	Professeur agrégé à la division des biostatistiques, *Thomas Jefferson University* (Philadelphie, PA), États-Unis Président de la Section on Teaching of Statistics in the Health Sciences à la *American Statistical Association*, États-Unis
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Veuillez noter que leurs contributions n'ont pas été soumises à une revue par les pairs.
Please note that their contributions were not subject to peer-review.

Lettre de la Royal Statistical Society
Letter from the Royal Statistical Society

4th March 2014

Dear Interdisciplinary Journal of Health Sciences,

I am writing to you as President of the Royal Statistical Society. We are an international Society of statisticians with 6,000 Fellows around the world, and we celebrate our 180th anniversary this year. We were one of the organisations behind the International Year of Statistics, and we were very pleased that you were an active partner in this celebration of statistics.

I was delighted to hear that you are publishing a special issue in 2014 on the critical role of statistics in analysing the determinants of health. You are building on a long and wonderful tradition. To give one example from our own history, Florence Nightingale pioneered the use of statistics in the Crimean War to show how unsanitary conditions in hospitals were a principal cause of high mortality rates. She was the first woman to be elected a Fellow of the Royal Statistical Society in 1858.

May I congratulate all of your authors and readers on their interest in this critical area, and I hope that you will be inspired by the work of early pioneers such as Nightingale and will follow in their footsteps.

All of us at the Royal Statistical Society wish you the very best in the work you are doing.

Yours sincerely,

John Pullinger
President | Royal Statistical Society

Objectivity, Subjectivity and Statistical Evidence

Michael EVANS

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Statistics has applications in many fields. The point behind all of these applications is that there are questions for which there is no obvious way that we can obtain definitive answers. The reason for this lies in variation, which can arise for many reasons, and this leads to uncertainty. The health sciences provides an excellent example of this as the variation among patients, such as physical, genetic and lifestyle characteristics, lead to different responses to a treatment for a health problem. We are then left with the questions of whether or not a treatment works and, if so, how well.

To be a problem for which statistical methodology is applicable, this variation must exhibit some regularity which we can model. The archetypal example of this is a population Ω, perhaps consisting of all individuals suffering from a particular disease, and a measurement X which is measured for each member ω of Ω. For example, $X(\omega)$ could be the blood pressure, measured in appropriate units, of individual ω in Ω. The population Ω and the measurement X lead to a distribution of the characteristic over the population as given by f_X, where $f_X(x)$ is the proportion of individuals in Ω that have $X(\omega) = x$ and we record this for each possible value x of X. So in a statistical application we want to know the distribution f_X. If we can conduct a census, namely, obtain $X(\omega)$ for every ω in Ω, then we know f_X exactly and there is no need for statistics.

In general, however, we will not be able to conduct a census and so we cannot know f_X exactly. For example, suppose we consider distributions $f_{1,X}$ and $f_{2,X}$ of measurement X over where $f_{i,X}$ corresponds to giving each member of treatment i where this is supposed to result in a lowering of blood pressure. If treatment 1 corresponds to a standard, we might want to know if treatment 2 is different in the sense that $f_{1,X}$ and $f_{2,X}$ are materially different. Clearly, even if we could do a census, we cannot simultaneously know both distributions. The statistical solution to this problem is to select a subset from Ω say $\omega_1, \ldots, \omega_n$, apply treatment 1 to $\omega_1, \ldots, \omega_{n1}$ and apply treatment 2 to $\omega_{n1+1}, \ldots, \omega_n$. After measuring these individuals, we have a sample $x_1 = X(\omega_1), \ldots, x_{n2} = X(\omega_{n1})$ from $f_{1,X}$ and a sample $x_{n1+1} = X(\omega_{n1+1}), \ldots, x_n = X(\omega_n)$ from $f_{2,X}$. We will use these data to make inferences about differences between $f_{1,X}$ and $f_{2,X}$, which are correspondingly inferences about differences in the treatments.

An important point here concerns how we should select $\omega_1, \ldots, \omega_n$ from Ω and the answer from statistics is unambiguous: we should use a random mechanism. Various reasons can be put forward for this but the most compelling for me is that it guarantees the *objectivity* of the data, namely, the data were generated by a mechanism which the investigators had no way of controlling. This is an important contribution from statistics.

The process we have described for generating data represents a gold standard. We do our very best to achieve it in any application. It is well-known, however, that it is rarely achieved in its ideal form. For example, we may not be able to sample from the full population Ω but have to rely on local participants or, even worse, it may be that the data we use is the result of an observational study where no known random mechanism was applied to generate the data. In such circumstances qualifications have to be applied to any conclusions we reach based on a statistical analysis. For example, while we would like our conclusions to apply to the full population Ω the fact that the data was not generated by random sampling from Ω means that our conclusions really don't apply that broadly. This doesn't mean that the results should be summarily dismissed as useless, only that we must be wary of any conclusions drawn. We can still consider the results of an analysis as evidence concerning the questions of interest but just not at the highest level of evidence that we would have obtained through proper random sampling.

The important point here is that statistics works via establishing gold standards and in any applied statistical analysis we strive hard to reach this standard as closely as possible to present the highest possible form of evidence. Any consumer of a statistical analysis must, however, ask themselves, what could have gone wrong because of any deficiencies in the way the data were collected. While the gold standard for the data collection phase of a statistical analysis is fairly easy to establish, and it is one to which most statisticians adhere to, the statistical inference or analysis phase is more problematical. There are a wide variety of opinions about the appropriate approach to sta-

tistical inference and unfortunately different approaches sometimes conflict in the sense that they give contradictory answers. This is a fundamental ambiguity that statistics has yet to collectively resolve.

Perhaps the most well known point of contention about inference is the Bayesian versus frequentist argument. There are many variations of this, and this short essay can't delve into all of them. The essence of the debate, however, can be summarized by saying that, while the Bayesian approach acknowledges the *subjectivity* in a statistical analysis, and even tries to make a virtue of it, a frequentist make claims of objectivity for their inferences based upon the long-run behavior of these procedures. For example, a 95% confidence interval for an unknown characteristic of the distribution of X will cover the true value of the characteristic in 95% of future samples of the same size we imagine taking from the same population.

While the frequentist criterion seems reasonable, there are problems with this approach to such an extent that the writer of this essay is a Bayesian. There are several reasons for this.

Perhaps foremost concerns the reason statistics exists as a subject. At least for me, statistics exists to tell people how one is to reason in statistical contexts. The archetypal statistical context is just as described in the first few paragraphs. A theory that fails to tell us exactly how we are to reason in very simple situations like this cannot, in my view, be seen as an acceptable theory of statistical inference. And yet this is the case for frequentist approaches to statistical inference as there does not exist a compete theory of frequentist inference, free of ambiguities.

One could argue that further research could one day fill in the gaps in a way that most statisticians find acceptable. This is certainly possible, but a detailed study of the problem does not make me optimistic.

Another concern, with various approaches to statistical inference, lies with any claim of objectivity of the analysis. In reality, all statistical analyses depend on choices made by the analyst either explicitly or implicitly. For example, why do we often assume (choose) normality as a possible distribution of a quantitative variable X? Whenever a statistical analysis is dependent on a choice like this, it is inherently subjective as the conclusions are dependent on the option chosen. This is not necessarily bad as it is often the case that we can check such choices against the only truly objective part of a statistical analysis, at least when it is collected correctly, the data. Indeed in a frequentist analysis we can check the sampling model against the data to see if the model is reasonable. This is known as *model checking*. Even if the model passes its checks, however, this does not make the sampling model, or the inferences drawn from it, objective. We have only followed good scientific practice to see if our assumption is in a sense falsified by the data. There is a logical concomitant to this: we should not use ingredients in statistical analyses that can't be falsified by the data. This eliminates a number of ingredients commonly used in statistical analyses such as loss functions.

It is not well understood that the most controversial aspect of a proper Bayesian analysis, namely, the prior, which expresses beliefs about the true f_X, can be checked against the data. A 'falsified' prior is one where there is an indication that the truth lies in the tails of the prior. If such a prior has a big impact on the analysis, then surely we wouldn't want to use it just as we wouldn't use a sampling model where the data lay in the tails of every distribution in the model. A relevant reference for *checking for prior-data conflict* can be found at the following link.

http://ba.stat.cmu.edu/journal/2006/vol01/issue04/evans.pdf

Once we have a sampling model, a prior and the data, then it is possible to provide a measure of *statistical evidence* that leads to a complete theory of statistical inference. Details on this can be found at the following link.

http://ba.stat.cmu.edu/journal/2013/vol08/issue03/evans.pdf

All the ingredients used in this theory of statistical inference are falsifiable and no inference problems are left unanswered. Of course, this does not mean that all statistical problems are solved. In specific problems we still have to come up with relevant models, elicitation procedures for priors, and implement model checking, checking for prior-data conflict and inference based upon the measure of statistical evidence.

Beyond the data, statistical analyses are never objective as they are dependent on subjective choices made by the investigator. Perhaps this is true of all empirical scientific investigations. Part of the role of statistics is to tell us how to assess the effects and relevance of our subjective choices and, most importantly, give us a complete and logical approach to reasoning in statistical contexts.

Éducation et santé : construire des indicateurs en comparaison internationale

Patrice DE BROUCKER Réseau de l'Organisation de Coopération et de Développement Économique (OCDE) sur les retombées professionnelles, économiques et sociales de l'apprentissage

Introduction

De nos jours, on traite souvent de l'éducation comme d'un sésame de l'accès à l'emploi – plus élevé est votre niveau de scolarité et meilleur est votre champ d'étude, meilleures sont vos chances d'obtenir rapidement un emploi stable, rémunérateur et gratifiant. Certes, c'est important et il y a là une considération que personne ne peut ignorer lorsque vient le moment de faire des choix d'orientation scolaire et de carrière. Mais il serait inconvenant de ne penser l'éducation et son rôle dans la vie qu'en de tels termes. L'éducation est source de nombreux autres bénéfices tant pour l'individu que pour la société.

Nous souhaitons, dans ce bref article, éveiller le lecteur au contexte dans lequel se fait le développement d'indicateurs liant éducation et santé, et à leur intérêt pour la comparaison à l'international. Pour elle-même et peut-être encore plus en raison de son influence importante sur l'emploi et la qualité de vie des individus, l'éducation est l'un des déterminants reconnus de la santé (Sanni Yaya, 2010). Cela justifie amplement l'intérêt qu'y portent les organisations internationales, telles que l'Organisation Mondiale de la Santé (OMS), l'Organisation de Coopération et de Développement Économiques (OCDE) et la Commission européenne. En cherchant à comparer les situations nationales sur la base d'indicateurs reconnus et calculés de la manière la plus standardisée possible, ces organisations cherchent à monter des bases documentaires riches, à tirer des enseignements de la « performance » relative des pays et à émettre des recommandations de politiques.

*Qu'est-ce qu'un indicateur ? Un **indicateur** est une mesure standardisée, fondée sur des données chiffrées, qui vise à opérationnaliser un concept, pour évaluer une situation, permettre des comparaisons dans le temps et dans l'espace, comme outil d'aide à la décision.*

La relation entre l'éducation et la santé est de plus en plus documentée. L'éducation peut avoir une relation directe avec l'état de santé et les comportements en matière de santé en amenant les individus à choisir des styles de vie sains et à se détourner de comportements préjudiciables à la santé. L'éducation peut aussi avoir une relation indirecte avec la santé, dans la mesure où les individus plus instruits sont plus susceptibles d'accéder à des emplois stables, bien rémunérés, qui leur procurent des moyens qui favorisent une vie en meilleure santé. Mais, clarifions un point au départ : la notion même de « déterminant », telle que dans l'expression « déterminants de la santé », sera souvent comprise comme présentant une relation de causalité entre la situation du paramètre donné, ici le niveau de scolarité, et l'état de santé, c'est-à-dire qu'un plus haut niveau de scolarité « causerait » un meilleur état de santé. Des techniques d'enquêtes particulières et des traitements statistiques appropriés permettent d'appréhender de telles relations de causalité. Ce n'est toutefois pas l'approche généralement utilisée dans la présentation d'indicateurs, que ce soit dans le domaine de la santé, de l'éducation ou autres. Les « indicateurs » tendent plutôt à expliciter des relations entre différentes variables. Certes, de telles relations peuvent alors être difficiles à interpréter hors d'une relation causale, et pourraient difficilement mener à des conclusions de politique claires en elles-mêmes. Mais ces relations prennent une dimension intéressante lorsque nous les examinons dans des contextes nationaux différents, puisque nous présenterons quelques indicateurs de relations entre niveau de scolarité et aspects de la santé en comparaison internationale. On notera également l'intérêt du suivi des indicateurs dans le temps, en construisant des séries chronologiques.

Nous verrons quelques exemples particuliers de construction d'indicateurs pertinents présentant la relation entre niveau de scolarité et des aspects importants de la santé : **la perception individuelle de son état de santé, l'obésité et l'espérance de vie**. Nous avons vu ci-dessus rapidement qu'il ne fallait pas inférer une causalité lorsque l'on met en évidence une relation (qui peut être mesurée statistiquement par une *corrélation* – mesure statistique de la relation entre deux variables ou plus). Dans le cadre

de cette présentation d'indicateurs, nous aborderons également les notions de *contrôle statistique* – suppression statistique de l'influence d'un élément externe sur chacun des deux phénomènes –, d'approche par des *données subjectives* – données liées intrinsèquement à la perception de l'individu – et par des *données objectives* – données indépendantes de toute perception individuelle.

Dans le cadre du programme des indicateurs des systèmes d'enseignement de l'OCDE (INES), une place importante est faite aux retombées sociales de l'éducation, dont plusieurs indicateurs en relation avec la santé. Les exemples de cet article et les données sous-jacentes aux graphiques viennent de plusieurs publications de l'OCDE, en particulier *Regards sur l'éducation* [1], publié annuellement.

1 – Éducation et sentiment de bonne santé

Le premier exemple d'indicateur est celui qui présente la relation entre la perception individuelle de l'état de santé et le niveau de scolarité. La mesure de la perception de l'état de santé correspond au pourcentage d'adultes (25 à 64 ans) qui s'estiment au moins en « bonne » santé (sur une échelle de 4 ou 5 points). C'est le traitement typique de *données subjectives*. La population adulte est répartie en trois groupes selon le niveau de scolarité : sans diplôme du secondaire, diplômés du secondaire, et diplômés de l'enseignement supérieur. Un choix restreint de pays est retenu pour illustrer le propos [2].

Le Graphique 1 nous présente plusieurs informations intéressantes. La couleur identifie les trois niveaux de scolarité : la longueur de la barre **bleue** nous indique la proportion de la population adulte sans diplôme du secondaire qui estime être en bonne santé – le « classement » des pays, de l'Irlande en haut du graphique à la République tchèque en bas, est en ordre décroissant de la proportion de cette population qui se perçoit en bonne santé; la partie **rouge** de la barre s'ajoute à la barre bleue pour indiquer la proportion de la population avec diplôme du secondaire qui estime être en bonne santé – une proportion toujours supérieure à celle de la population sans diplôme; la partie **verte** de la barre s'ajoute aux deux précédentes pour indiquer la proportion des adultes ayant un diplôme d'études supérieures qui se perçoivent en bonne santé – à nouveau, cette proportion est toujours supérieure aux deux précédentes. La variation incrémentale de l'état de santé associée à l'élévation du niveau de formation (de 12 à 44 points de pourcentage parmi les pays inclus ici) est ce que l'on appelle le « gradient d'éducation ».

Trois premières conclusions se dessinent, en ne considérant pour le moment que les barres du haut (« Pas de contrôle ») pour chacun des pays :

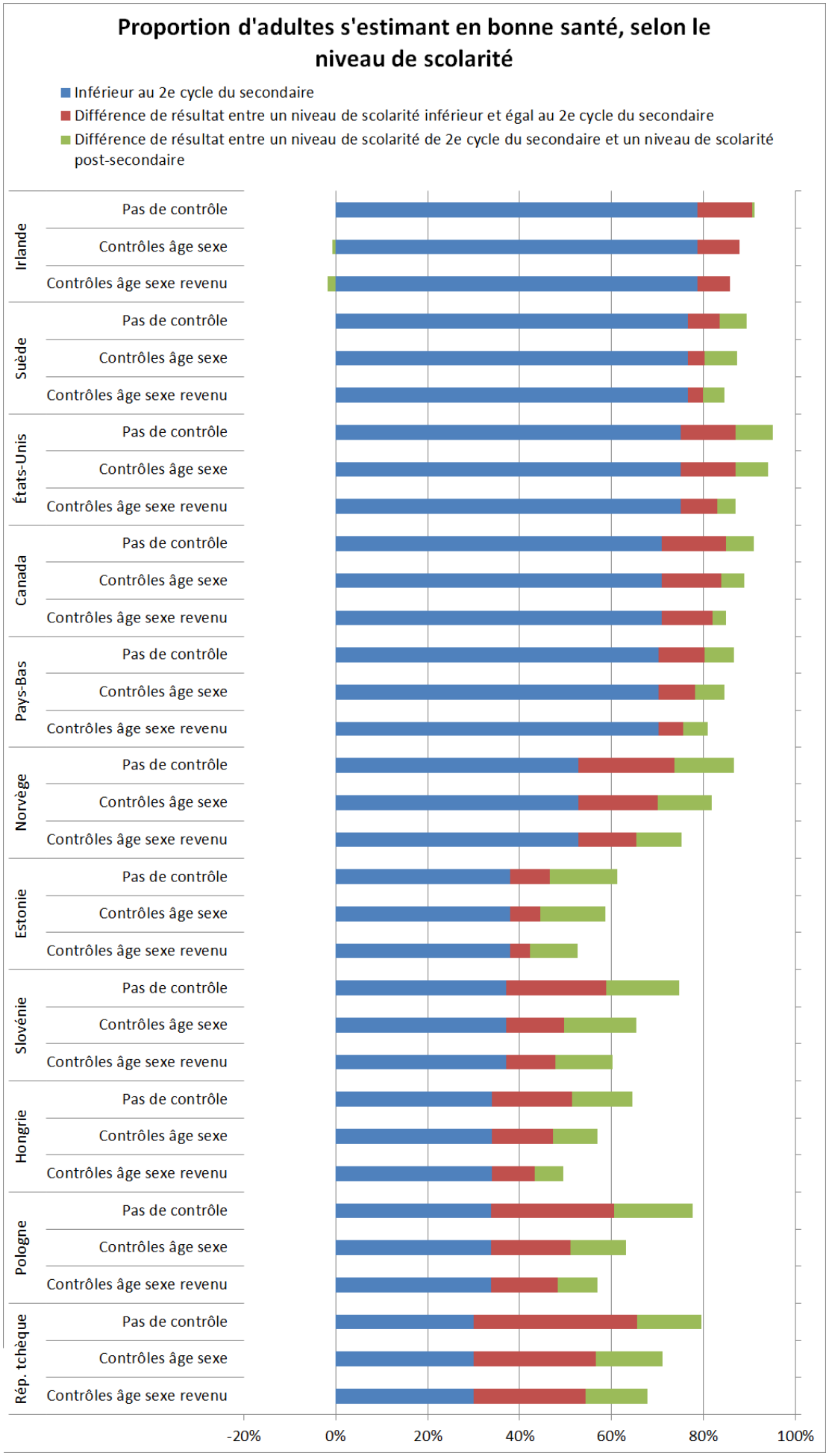
1. à niveau de scolarité équivalent, la perception d'être en bonne santé varie considérablement d'un pays à l'autre;

2. dans tous les pays, le sentiment d'être en bonne santé croît avec le niveau de scolarité, mais les bénéfices qui sont associés aux plus hauts niveaux de scolarité varient tout de même sensiblement d'un pays à l'autre;

3. dans tous les pays sauf un, le gain marginal de sentiment de bonne santé est plus élevé chez la population diplômée du secondaire par rapport à celle sans diplôme que celui obtenu par la population diplômée d'études supérieures par rapport à celle diplômée du secondaire (la barre rouge plus longue que la barre verte) – information potentiellement intéressante pour les décideurs politiques quant à la « rentabilité » relative d'effort de santé publique dans les écoles secondaires.

Comme en avise l'OCDE, il convient d'interpréter ces données « avec prudence, étant donné les biais (y compris culturels) significatifs qui ne sont pas à exclure entre les pays lorsque les individus rendent compte de leur état de santé » (OCDE, 2010, p. 160). On ne peut pour autant négliger ce que nous disent de telles données « subjectives » : dans notre vie, prend-on toujours des décisions qui nous affectent en fonction de données « objectives »? Ne sommes-nous pas plus souvent menés par nos perceptions, surtout peut-être celles relatives à notre santé? Ces premières conclusions sont le fruit d'une lecture directe des résultats d'enquêtes, sans traitement statistique particulier, lecture qui, pour chaque pays se fait sur la barre intitulée « Pas de contrôle » (sans *contrôle statistique*).

Dans quelle mesure cette perception de l'état de santé varie-t-elle selon le niveau de scolarité, avec et sans contrôle des différences individuelles de sexe, d'âge et de revenus? On note que, pour chaque pays, nous présentons trois barres horizontales. Plus haut, nous avons présenté une lecture directe de la barre sans *contrôle statistique*. Que nous apportent les deux autres barres? La relation entre le niveau de scolarité et le sentiment d'être en bonne santé peut, elle-même, être influencée par des éléments sous-jacents, qui, eux-mêmes, peuvent affecter aussi bien le niveau de scolarité que la perception de l'état de santé – on pourrait considérer que ce sont des **variables dites**



Graphique 1

Proportion d'adultes s'estimant en bonne santé, selon le niveau de scolarité.
Note. Adapté de "Regards sur l'éducation 2011: Les indicateurs de l'OCDE," par OCDE, 2011. Copyright 2011 par OCDE.

« confondantes », car elles pourraient affecter la relation observée. Que l'on pense par exemple à l'âge : une personne jeune « moyenne » est souvent plus scolarisée qu'une personne plus âgée; elle sera aussi probablement plus souvent en bonne santé – et plus susceptible de se percevoir comme telle – qu'une autre plus âgée. On peut également penser que le sexe peut jouer un certain rôle, même si l'analyste n'a pas besoin de déterminer a priori ce rôle – le sexe est d'ailleurs un des déterminants de la santé. Autre déterminant de la santé qui peut être une variable confondante dans la relation entre le niveau de scolarité et l'état de santé : le revenu. Celui-ci est lui-même corrélé avec le niveau de scolarité. Essayer de prendre en compte explicitement l'effet de telles variables confondantes est précisément la raison d'être des exercices statistiques sous-jacents aux deux autres barres pour chacun des pays. La question que l'on se pose alors est la suivante : en prenant comme référence la population sans diplôme du secondaire, si nous éliminions l'effet de l'âge et du sexe dans les populations avec un plus haut niveau de scolarité, quel serait **l'effet net** du diplôme sur la perception de l'état de santé? La réponse à cette question est générée par une analyse de régression qui permet de « contrôler statistiquement » pour l'âge et le sexe – une mesure de la relation entre niveau de scolarité et sentiment de bonne santé à conditions d'âge et de sexe identiques. La comparaison des barres « Contrôles âge sexe » et « Pas de contrôle » permet de présenter les conclusions suivantes :

1. dans tous les pays, et quel que soit le niveau de scolarité supérieur au sans diplôme (la barre bleue), aussi bien la rouge que la verte se réduit ce qui indique que la composition âge-sexe, différente dans les deux groupes de population plus diplômés, joue un rôle positif dans l'amélioration de la perception de bonne santé chez les populations plus scolarisées;

2. toutefois, puisque les barres rouges et vertes ne disparaissent pas totalement, il demeure, après contrôle, une relation forte de la scolarisation avec la perception de l'état de santé;

3. des différences demeurent notoires entre pays : par exemple, l'incidence combinée de l'âge et du sexe est pratiquement nulle aux États-Unis et très faible au Canada (un à deux points de pourcentage seulement), tandis qu'elle est un facteur plus important – parfois jusqu'à compter pour près de dix points de pourcentage – en République tchèque, en Pologne et en Slovénie.

La relation établie ne semble donc pas dépendre, au premier chef, des différences de niveau de scolarité entre les sexes ou entre les groupes d'âge.

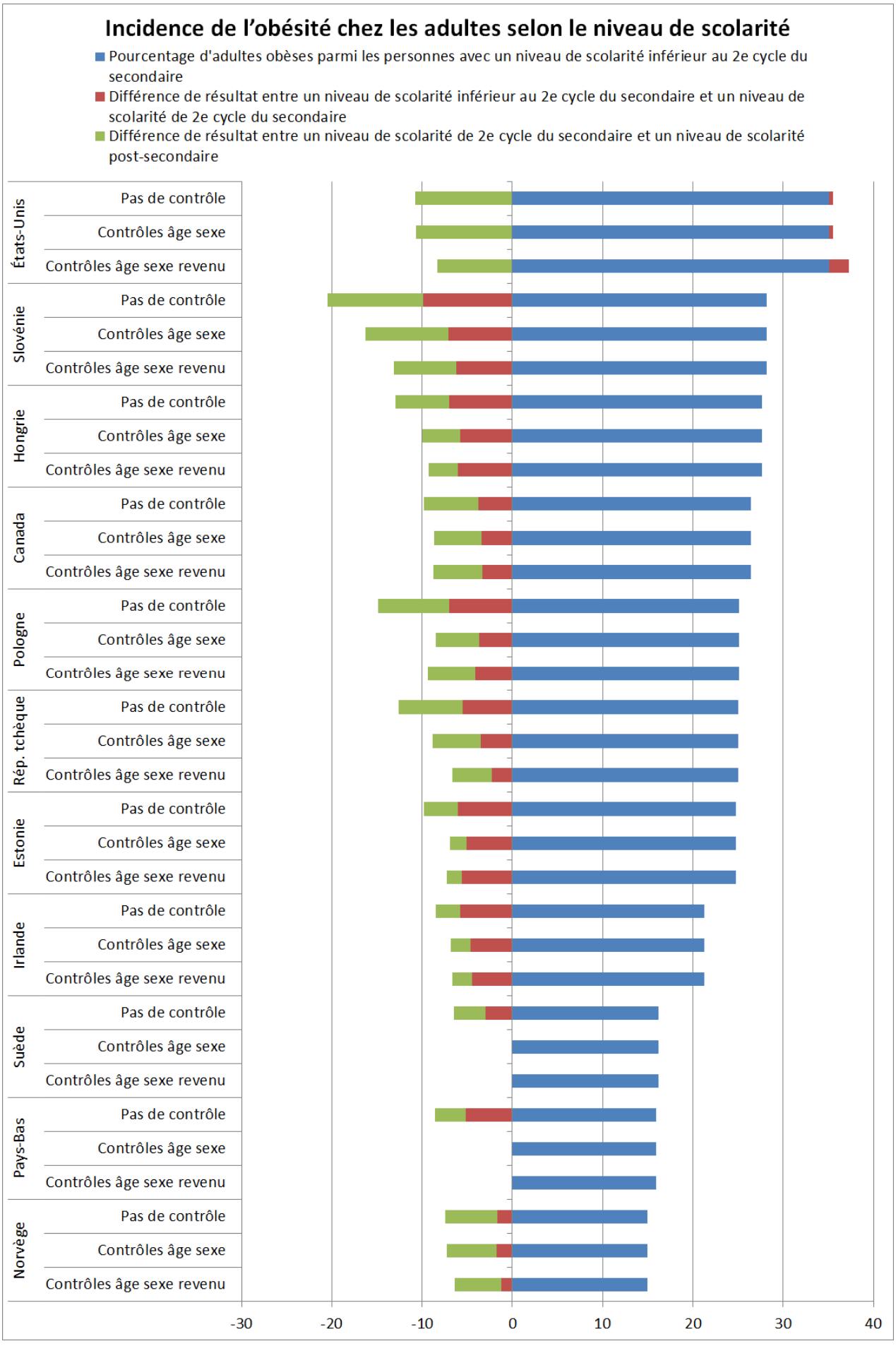
De la même manière, on peut « contrôler » en plus pour l'effet revenu. En reconnaissant qu'une bonne part de cet effet peut être déjà absorbée par l'effet âge-sexe précédent, on mesure alors l'effet additionnel du revenu. Celui-ci se révèle significatif dans la plupart des pays et dans un sens qui renforce celui de la combinaison âge-sexe. Il est le plus important, semble-t-il dans les pays où l'effet âge-sexe était le plus faible (États-Unis, Canada). La corrélation entre le niveau de scolarité et la perception de l'état de santé tend à perdre de son intensité si le revenu est contrôlé, ce qui donne à penser que le revenu compte parmi les variables explicatives de cette relation.

Dans la plupart des pays, la corrélation entre niveau de scolarité et sentiment d'être en bonne santé reste forte même après ajustement tenant compte de l'âge, du sexe et du revenu des individus. En d'autres termes, ce que les individus sont susceptibles d'acquérir au travers de l'apprentissage et de la formation – en l'occurrence des compétences et des qualités socio-émotionnelles et cognitives – contribue significativement à l'amélioration des retombées sociales, indépendamment de l'impact de ces variables.

2 – Éducation et obésité

L'obésité a été désignée comme un des problèmes prioritaires de santé publique. Notre second exemple examine la relation entre niveau de scolarité et mesure de l'obésité. Dans ce cas, il s'agit d'une mesure objective puisque l'on demande lors de l'enquête la taille et le poids du répondant [3]. La mesure de l'obésité est le classique indice de masse corporelle (le poids en kilogrammes, divisé par le carré de la taille en mètres). Selon l'Organisation Mondiale de la Santé, les adultes dont l'IMC atteint ou dépasse 30 sont considérés comme obèses.

En suivant la même approche que dans la section précédente, nous obtenons le Graphique 2 couvrant un ensemble identique de pays. Les barres bleues représentent la proportion de personnes obèses parmi la population sans diplôme du secondaire. Cette proportion sert de base tant pour mesurer la différence enregistrée dans les populations avec des niveaux de scolarité plus élevés, que pour l'incidence du contrôle pour l'âge, le sexe et le revenu. Ici encore, la relation entre le niveau de scolarité et l'obésité



Graphique 2

Incidence de l'obésité chez les adultes selon le niveau de scolarité.
Note. Adapté de "Regards sur l'éducation 2013: Les indicateurs de l'OCDE," par OCDE, 2013. Copyright 2013 par OCDE.

est évidente et les différences entre pays le sont aussi. Dans tous les pays retenus, selon la lecture directe de l'incidence (« Pas de contrôle »), une scolarisation plus longue vient en moyenne diminuer l'incidence de l'obésité (les barres rouges et vertes s'inscrivent, dans ce graphique, en diminution de l'incidence) – seulement aux États-Unis, il n'y a pas de différence significative entre ceux qui n'ont aucun diplôme et ceux qui ont un diplôme du secondaire. Les différences entre les pays sont importantes : chez les adultes les plus vulnérables (ceux sans diplôme du secondaire), l'incidence de l'obésité atteint 35% aux États-Unis alors qu'elle est de 15% en Norvège. L'ampleur de la réduction de l'incidence de l'obésité avec la hausse du niveau de scolarité ne semble pas étroitement liée avec la situation nationale de départ pour les adultes sans diplôme.

La corrélation entre l'éducation et l'obésité dépend-elle dans une grande mesure de l'âge ou du sexe ? Une des hypothèses serait, par exemple, que les jeunes générations (ou les femmes) sont moins susceptibles d'être obèses, et qu'elles sont aussi plus instruites que les générations plus âgées (ou les hommes). Le Graphique 2 produit les estimations calculées à partir d'une régression qui vient éliminer les différences de composition des groupes de population par niveau de scolarité. Il donne à penser que la relation entre le niveau de scolarité et l'obésité reste étroite, même après contrôle de l'âge et du sexe. Lorsque l'on cherche à éliminer un effet confondant de l'âge et du sexe d'abord, puis du revenu en plus, on obtient en général le modèle attendu, une réduction de l'effet positif de la scolarisation plus élevée. Ce phénomène est important en Slovénie, en Hongrie et en République tchèque. Il est toutefois très atténué, voire inexistant dans les autres pays, démontrant alors que le niveau de scolarité a une relation avec l'obésité dans l'ensemble de la population adulte largement indépendante de ces variables.

Notre échantillon de pays est réduit, mais il semble tout de même singulier que la corrélation entre le sentiment de bonne santé et la réalité de ne pas être obèse soit faible. Bien que ce ne soit pas représenté ici, il est intéressant de noter que, s'agissant de l'obésité, le gradient d'éducation est le plus souvent plus important chez les femmes que chez les hommes.

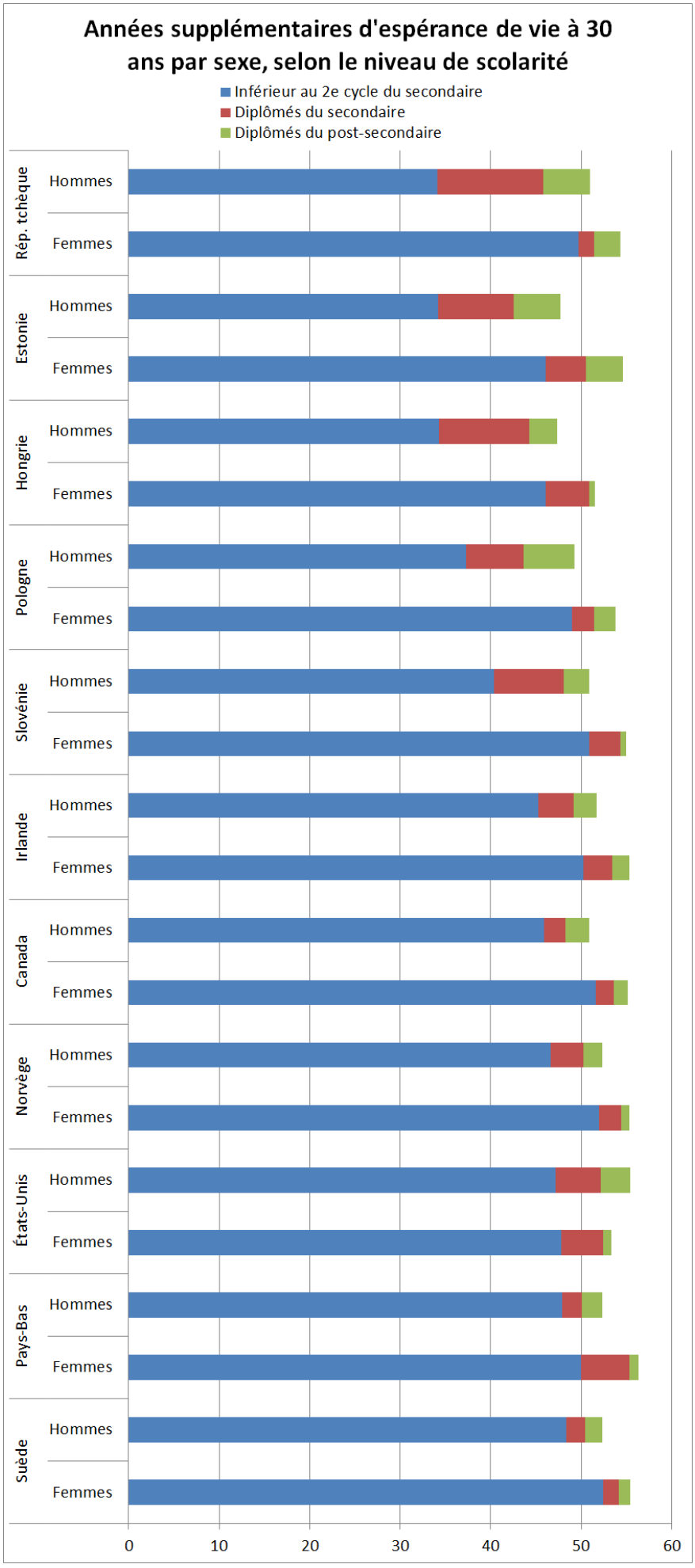
3 – Éducation et espérance de vie

L'espérance de vie d'une population est également un indicateur important de santé. Il est en quelque sorte un bon indicateur synthétique de la santé d'une population – ou, vu sous un autre angle et dans la perspective historique de croissance continue de l'espérance de vie, de la capacité d'un système de santé à maîtriser des risques de santé tout au long de la vie. Là encore, le niveau de scolarité apparaît étroitement associé à l'espérance de vie. Ici, la mesure retenue est celle de l'espérance de vie à l'âge de 30 ans, c'est-à-dire le nombre d'années supplémentaires qu'une personne peut, en moyenne, espérer vivre quand elle a atteint l'âge de 30 ans. Calculée à partir de données d'état civil (natalité et mortalité par âge), l'espérance de vie est un indicateur typiquement « objectif », ne dépendant que de faits avérés. L'importance de la différence selon le sexe nous amène à présenter directement cette perspective dans le Graphique 3.

Dans tous les pays, le gradient éducation est manifeste – les barres rouges et vertes traduisent des années supplémentaires d'espérance de vie associées à des niveaux de scolarité supérieurs. Dans tous les pays et pour tous les niveaux de scolarité, l'espérance de vie à trente ans est sensiblement supérieure chez les femmes [4]. Toutefois, sauf aux Pays-Bas, l'éducation est un facteur associé à une augmentation de l'espérance de vie nettement supérieure chez les hommes que chez les femmes. Ceci signifie que la différence d'espérance de vie selon le sexe est plus large chez les personnes dont le niveau de scolarité est le plus faible que chez celles dont le niveau de scolarité est le plus élevé.

Les différences parmi les pays dont nous présentons les données sont importantes. Dans quatre pays européens (Estonie, Hongrie, Pologne et République tchèque), l'espérance de vie chez les hommes au plus faible niveau de scolarité est sensiblement en-deçà de 40 ans. Mais ce sont les quatre pays dans lesquels les gains associés à la hausse du niveau de scolarité sont les plus élevés. Globalement, parmi les pays présentés, les gains plus élevés d'espérance de vie associés au niveau de scolarité parmi les hommes permettent une réduction de la moyenne des écarts d'espérance de vie entre hommes et femmes de 7 ans et demi à 3 ans et demi.

De manière fort intéressante, avec l'allongement continu de l'espérance de vie, l'accent s'est porté récemment sur la « qualité » de l'expérience de vie ainsi prolongée. De nouveaux développements statistiques permettent de mesurer **l'espérance de vie en bonne santé** – les années qui se gagnent en longévité sont-elles des années de vie en bonne santé? Le concept statistique n'est pas encore vraiment stabilisé et plusieurs méthodes de calcul sous-jacentes font l'objet d'études. Au Canada (Statistique Canada), on re-



Graphique 3

Années supplémentaires d'espérance de vie à 30 ans par sexe, selon le niveau de scolarité. *Note.* Adapté de "Regards sur l'éducation: Les indicateurs de l'OCDE," par OCDE, 2012a. Copyright 2012 par OCDE.

trouve, semble-t-il, deux approches : l'espérance de vie ajustée sur l'incapacité, dont le calcul utilise des données d'enquêtes sur la limitation d'activité, et l'espérance de vie ajustée sur la santé, dont le calcul utilise un indice d'état de santé, lui-même fondé sur les conditions courantes de morbidité et de mortalité (Statistique Canada, 2014a). Les développements internationaux sont aussi importants, tels par exemple ceux de l'Organisation Mondiale de la Santé, de l'Organisation de Coopération et de Développement Économiques et de la Commission européenne (Eurostat) [5]. Mais, pour le moment, on ne connaît pas encore de calcul de l'espérance de vie en bonne santé selon le niveau de scolarité – ce serait certainement un développement statistique très intéressant et pertinent.

Puisque nous avons vu la relation significative entre l'espérance de vie et le niveau de scolarité, il est intéressant de noter que l'écart entre l'espérance de vie en santé et l'espérance de vie, toutes deux calculées à la naissance, est aussi significatif : selon les données les plus récentes pour le Canada, basées sur les tables de décès de 2005 à 2007, l'espérance de vie en santé des hommes était de 68,9 années pour une espérance de vie totale de 78,3 années, tandis que ces valeurs étaient respectivement de71,2 années et 83 années pour les femmes – la différence d'espérance de vie entre hommes et femmes est réduite de moitié lorsque l'on considère l'ajustement prenant en compte l'état de santé (Statistique Canada, 2014b).

Ces quelques exemples montrent l'intérêt de l'utilisation de méthodes statistiques parfois sophistiquées pour comprendre et analyser des relations importantes au cœur de notre vie sociale et de notre économie. La mondialisation rend également plus pressant l'engagement des organisations internationales dans la compréhension et l'analyse de ces relations dans un contexte de comparaisons internationales, qui permet de partager des expériences nationales et de tirer parti des situations exemplaires.

Notes :

[1] Pour plus d'informations sur les Regards sur l'éducation, voir (OCDE, 2014).

[2] Un plus grand nombre de pays couverts peut être trouvé dans (OCDE, 2011).

[3] Disons qu'il s'agit d'une mesure « plus » objective car il reste que la mesure dépend de la réponse bien informée (« honnête ») du répondant à l'enquête.

[4] Une seule exception serait la longévité un peu supérieure chez les hommes américains ayant un niveau de scolarité post-secondaire.

[5] Voir, par exemple, deux chapitres sur l'espérance de vie en santé dans (OCDE, 2012b).

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Education and Health: Building Indicators in International Comparison

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Introduction

Nowadays, we often analyze the benefits of education as a sesame to access employment – the higher your level of education and better your field of study, the better your chances of getting quickly a stable, well paid and rewarding job. Surely this is important and it is a consideration that nobody can ignore when it comes to making a choice of a pathway through school and a career. But it would be inappropriate to think of education and its role in life only in such terms. Education is a source of many other benefits both for the individual and for society.

In this brief article, we wish to draw the attention of the reader to the context for the development of indicators linking education and health, and to their interest in international comparisons. In itself and perhaps even more because of its impact on employment and quality of life, education is one of the recognized determinants of health (Sanni Yaya, 2010). This fully justifies the interest born by international organizations such as the World Health Organization (WHO), the Organisation for Economic Cooperation and Development (OECD) and the European Commission. In seeking to compare national situations on the basis of indicators jointly designed and calculated in the most standardized way possible, these organizations develop rich databases and metadata allowing us to learn from the relative "performance" of countries and to issue policy recommendations.

*What is an indicator? An **indicator** is a standardized measure, based on statistical data, which seeks to operationalize a concept to assess a situation, make comparisons over time and space, as a tool for decision making.*

The relationship between education and health is increasingly documented. Education can have a direct relationship with the state of health and health behaviours by bringing people to choose healthy lifestyles and to turn away from harmful health behaviours. Education can also have an indirect relationship to health, to the extent that more educated individuals are more likely to have access to stable jobs that pay well, which give them ways and means towards a healthier life. But, let's clarify a point at the start: the concept of "determinant", as in the expression "determinants of health", will often be understood as reflecting a causal relationship between the situation of the given parameter, i.e. here the education level, and health status, that is to say that a higher level of education would "cause" a better state of health. Specific survey techniques and appropriate statistical tools help apprehend such causal relationships. However, such approaches are not commonly used in the presentation of indicators, whether in the field of health, education or other. "Indicators" tend rather to clarify relationships between different variables. It is true that such relationships may then be difficult to interpret out of a causal relationship, and could not easily lead to clear policy conclusions by themselves. But these relationships are taking an interesting dimension when we look at them in different national contexts, as we will present some indicators of relationships between education and aspects of health issues in international comparison. Note also the interest of monitoring indicators over time, through building time series.

We will look at some specific examples of the construction of relevant indicators showing the relationship between education and important aspects of health: **the individual's perception of their own health, obesity and life expectancy**. We saw above that we should not quickly infer causality when we show evidence of a relationship (which can be measured statistically by a *correlation* – a statistical measure of the relationship between two or more variables). As part of the presentation of indicators, we also discuss the concepts of *statistical control* – statistical suppression of the influence of an external element on each of the two related phenomena –, and approach issues with *subjective data* – data intrinsically linked to the perception of the individual – and *objective data* – data independent of any individual perception.

Under the OECD Indicators of Education Systems (INES) programme, an important place is given to the social benefits of education, several indicators being related to health. The examples in this article and the data underlying the figures come from several OECD publications, especially *Education at a Glance* [1], published annually.

1 – Education and self-reported good health

The first example is the indicator showing the relationship between the individual's perception of good health and education. The measure of the perception of health status is the percentage of adults (25-64 years) who consider themselves at least in 'good' health (on a scale of 4 or 5 points). *Subjective data* is typically treated in this manner. The adult population is divided into three groups by highest level of education: no high school diploma, high school graduates, and graduates of higher education. A small selection of countries was chosen to illustrate the point [2].

Figure 1 presents some interesting information. Color identifies the three levels of education: the length of the **blue** bar indicates the proportion of the adult population without a high school diploma who report being healthy – the "ranking" of countries, Ireland at the top of the figure to the Czech Republic at the bottom, is in decreasing order of the proportion of the population that reports being healthy; the **red** part of the bar is added to the blue bar to indicate the proportion of the population with a high school diploma who report being healthy – always a proportion higher than that of the population without a diploma; the **green** portion of the bar is added to the previous two to indicate the proportion of adults with a postsecondary credential who perceive themselves healthy – again, this proportion is higher than the previous two. The incremental change in health status associated with rising levels of education (12 to 44 percentage points among the countries included here) is called the "education gradient".

Three conclusions emerge when considering first the top bar ("No control") for each country:

1. for any given level of education, the perception of good health varies considerably from one country to another;

2. in all countries, reporting being in good health increases with the level of education, but the benefits that are associated with higher levels of education still vary considerably from one country to another;

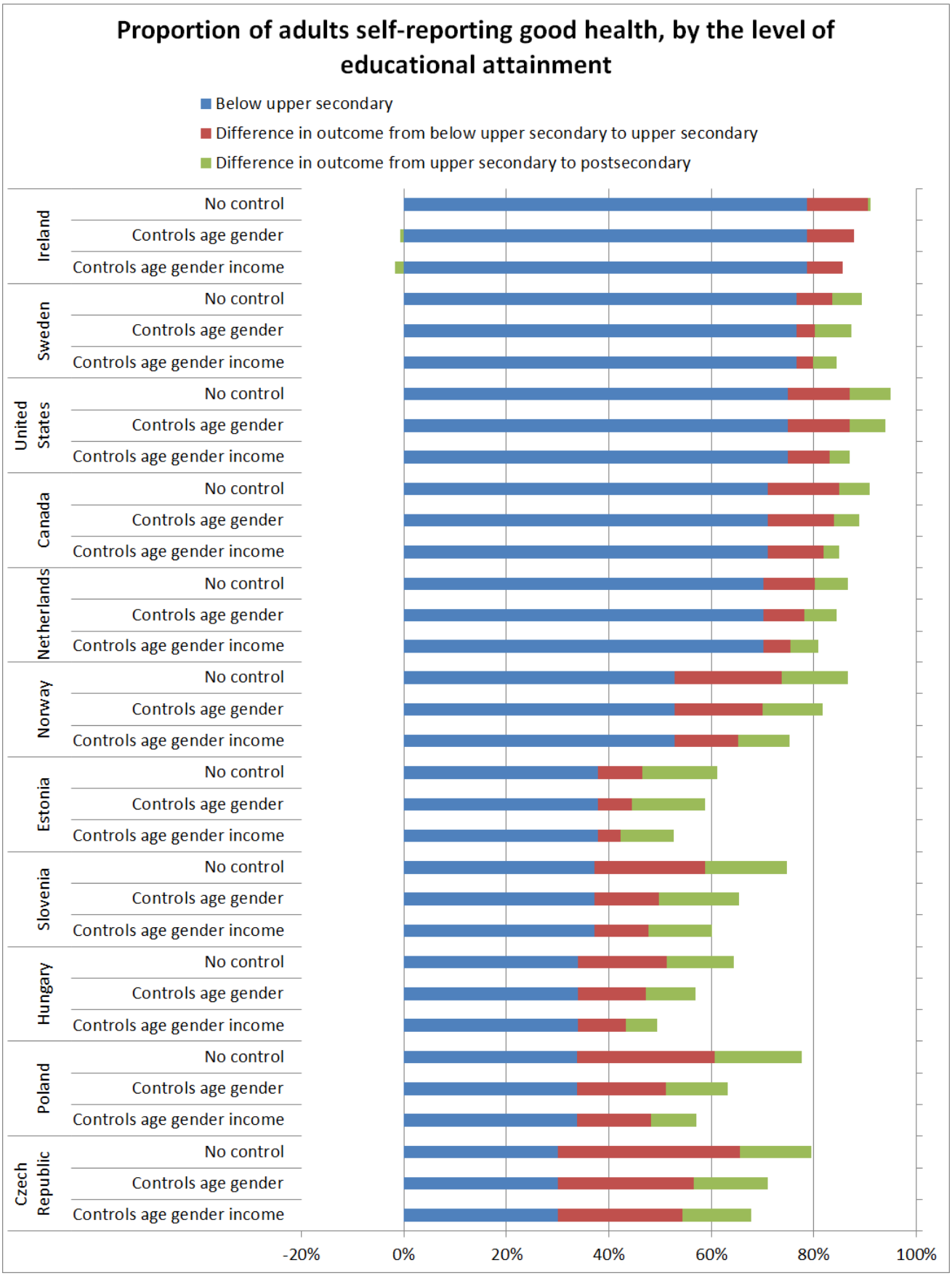
3. in all countries but one, the marginal gain in the perception of good health is higher among the population with a high school diploma compared to the population with no diploma than that obtained by the population with higher education compared to high school graduate (the red portion of the bar is longer than the green one). This is potentially useful information for policy makers about the relative "efficiency" of public health effort in secondary schools.

As the OECD advises, it is necessary to interpret these data "with caution, given the potentially significant cross-country bias (including cultural bias) in reporting one's health status" (OECD, 2010, p. 152). However, we cannot neglect what such "subjective" data tell us: in our lives, do we always make decisions that affect us based on "objective" data? Are we not more often carried by our perceptions, perhaps especially those relating to our health? These preliminary findings are the result of a direct reading of survey results, with no particular statistical processing, as the reading for each country is on the bars labeled "No control" (without *statistical control*).

To what extent this perception of health status does vary by level of education, with and without controlling for individual differences in gender, age and income? Note that, for each country, we present three horizontal bars. Above, we have presented a direct reading of the bar without *statistical control*. What do the other two bars give us? The relationship between education and the perception of being in good health may itself be influenced by underlying elements which, themselves, may affect both the level of education and the perception of health status – such elements could be considered as **"confounding" variables** because they could affect the observed relationship. One can think of age, for example: an "average" young person is often better educated than an older person; he/she will also probably more often be in better health – and more likely to perceive themselves as such – than an older person. One can also think that the person's gender may play some role, even if the analyst does not need to determine in advance what role – gender is also one of the determinants of health. Another determinant of health that may be a confounding variable in the relationship between education and health is income. It is itself correlated with the level of education. Trying to take into account explicitly the effect of such confounding variables is precisely the reason for the statistical exercises underlying the other two bars for each country. The question that arises is the following:

Figure 1

Proportion of adults self-reporting good health, by the level of educational attainment. *Note*. Adapted from "Education at a glance 2011: OECD indicators," by OECD, 2011. Copyright 2011 by OCDE.



taking as a reference the population without a high school diploma, if we eliminate the effect of age and gender in populations with a higher level of education, what would be **the net effect** of a diploma or a degree on the perception of health status? The answer to this question is obtained using a regression analysis that allows us to "statistically control" for age and gender – a measure of the relationship between educational attainment and the perception of good health in conditions where the composition of the population by age and gender would be similar to that in the population with no high school diploma. The comparison of the bars "Controls age gender" and "No control" presents the following conclusions:

1. in all countries, irrespective of the level of education higher than no high school diploma (the blue bar), both the red and green portions of the bars are reduced, indicating that the different age-gender composition in both more educated groups plays a positive role in improving the perception of good health among the more educated populations;

2. however, since the red and green bars do not disappear completely, it remains after having been controlled, indicating a strong relationship between the level of education and the perception of good health;

3. notable differences remain between countries: for example, the combined effect of age and gender is almost nil in the United States and very low in Canada (one to two percentage points only), while it is a more important factor – up to nearly ten percentage points – in the Czech Republic, Poland and Slovenia.

Hence, the relationship does not seem to depend, primarily, upon differences in educational attainment between genders or between age groups.

In the same way, we can additionally "control" for the income effect. Recognizing that much of this effect can already be absorbed by the previous age-gender effect, we actually measure the additional effect of income. It proves significant in most countries and in a way that reinforces the effect of age and gender. It is highest, it seems, in countries where the age-gender effect was lower (U.S., Canada). The correlation between educational attainment and perceived health status tends to lose its intensity when income is controlled for, which suggests that income plays a significant role among the explanatory variables in this relationship.

In most countries, the correlation between education level and the perception of good health remains strong even after adjustment for age, gender and individuals' income. In other words, what individuals may acquire through learning and training – namely skills, and socio-emotional and cognitive skills – generates significant social benefits, regardless of the impact of these variables.

2 – Education and obesity

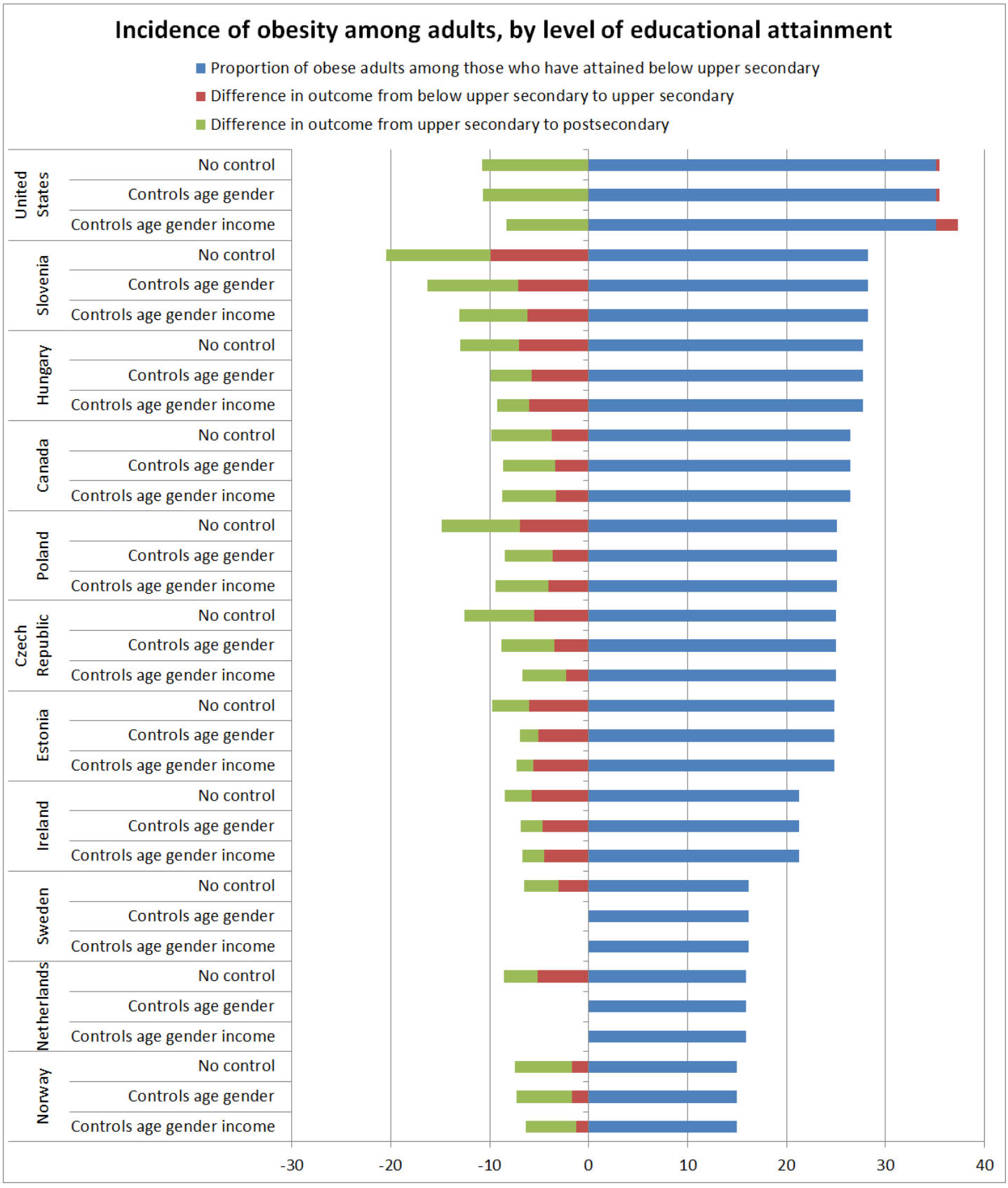
Obesity has been identified as a priority issue in public health. Our second example examines the relationship between educational attainment and a measure of obesity. In this case, it is an objective measure since respondents are asked in the survey to provide their size and weight [3]. The measure of obesity is the standard body mass index (BMI, the weight in kilograms divided by the square of the height in meters). According to the World Health Organization, adults with a BMI at or above 30 are considered obese.

Following the same approach as in the previous section, we obtain Figure 2 covering the same set of countries. The blue bars represent the proportion of obese people among the population without a high school diploma. This proportion is used as the basis for measuring both the difference recorded in populations with higher levels of education, and the impact of controlling for age, gender and income. Again, the relationship between education and obesity is obvious and the differences between countries are too. In all the selected countries, the direct reading of the prevalence of obesity ("No control"), shows that longer schooling on average is associated with a lower incidence of obesity (both red and green bars moving in the opposite direction indicate a decrease of incidence). Only in the United States, there was no significant difference in incidence of obesity between those who have no qualifications and those with a high school diploma. The differences between countries are high: among the most vulnerable adults (those without a high school diploma), the incidence of obesity is 35% in the United States while it is 15% in Norway. The magnitude of the reduction in the incidence of obesity with higher levels of education does not seem closely linked with the national baseline for adults without a diploma.

Does the correlation between education and obesity depend on age or gender to a large extent? One hypothesis would be, for example, that younger generations (or wom-

Figure 2

Incidence of obesity among adults, by level of educational attainment. *Note*. Adapted from "Education at a glance 2013: OECD indicators," by OCDE, 2013. Copyright 2013 by OCDE.



en) are less likely to be obese, and that they are also more educated than older generations (or men). Figure 2 produces estimates, calculated from a regression, that eliminate differences in composition of population groups by education level. It suggests that the relationship between education and obesity remains close, even after controlling for age and gender. When seeking to eliminate the confounding effect of age and gender first, then additionally the effect of income, we obtain the expected general model, i.e. an attenuation of the positive effect of higher education. This phenomenon is important in Slovenia, Hungary and the Czech Republic. It is, however, much limited or nonexistent in other countries, demonstrating that the level of education has a relationship with obesity in the adult population, largely independent of those variables.

Our sample of countries is reduced, but it is still somewhat surprising that the correlation between the perception of good health and the reality of not being obese is low. Although it is not shown here, it is interesting to note that, in the case of obesity, the education gradient is usually greater for women than for men.

3 – Education and life expectancy

The life expectancy of a population is also an important indicator of health. It is somehow a good summary indicator of the health of a population – or, seen from another angle and in the historical perspective of continued growth in life expectancy, the ability of a health system to control health risks throughout life. Again, the level of education appears to be closely associated with life expectancy. Here, we look at the life expectancy at the age of 30, i.e. the number of additional years a person can, on average, expect to live when he/she reaches the age of 30 years. Calculated from vital data (birth and death rates by age), life expectancy is a typical "objective" indicator, depending only on observed facts. The importance of gender differences leads us to directly present this perspective in Figure 3.

In all countries, the education gradient is clear – the red and green bars reflect additional years of life expectancy associated with higher levels of education. In all countries and at all levels of education, life expectancy at age 30 is significantly higher among women [4]. However, except in the Netherlands, education is a factor associated with an increase in life expectancy significantly higher for men than for women. This means that the difference in life expectancy by gender is larger among those whose education level is lower than among those whose education level is higher.

Differences among the countries for which we present the data are important. In four European countries (Estonia, Hungary, Poland and Czech Republic), life expectancy for men at the lowest level of education is substantially below 40 years, even though these are the four countries where the gains associated with higher levels of education are highest. Overall, among the countries presented, the higher gains in life expectancy associated with the level of education among men lead to a reduction in the average gap in life expectancy between men and women from 7 ½ years to 3½ years.

Interestingly, with continued lengthening of life expectancy, the focus has recently been put on the "quality" of the extended years of life. New statistical developments are taking place to measure **life expectancy in good health** – are the years gained in longevity years of healthy life? The statistical concept is not yet fully stabilized and several methods underlying the necessary calculations are under study. In Canada (Statistics Canada), there are, apparently, two approaches: the disability-adjusted life expectancy, for which the calculation uses data from the activity limitation survey, and health-adjusted life expectancy, for which the calculation uses a health index, itself based on the current conditions of morbidity and mortality (Statistics Canada, 2014a). International developments are also significant, such as those of the World Health Organization, the Organisation for Economic Cooperation and Development and the European Commission (Eurostat) [5]. For the moment, we do not yet know of a measure of life expectancy in good health by level of education – it would certainly be a very interesting and relevant statistical development.

Since we saw the significant relationship between life expectancy and level of education, it is interesting to note that the gap between life expectancy and healthy life expectancy, both calculated at birth, is also significant. According to the most recent data for Canada, based on death tables from 2005 to 2007, healthy life expectancy for men was 68.9 years for a total life expectancy of 78.3 years, while these values were 71.2 years and 83 years respectively for women – the difference in life expectancy between men and women is reduced by half when one considers the adjustment taking into account the state of health (Statistics Canada 2014b).

These examples show the importance of using sophisticated statistical methods to occasionally to understand and

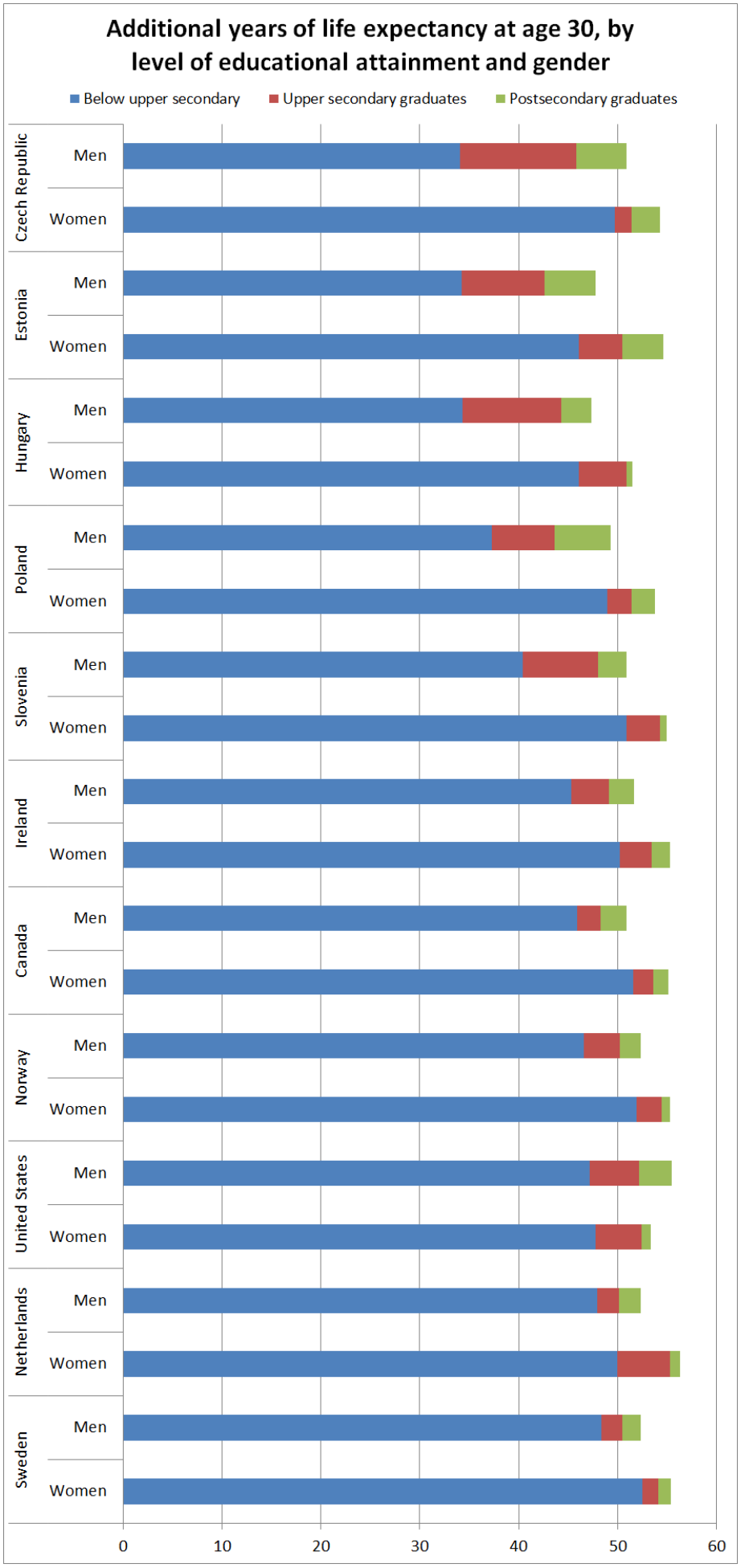


Figure 3

Additional years of life expectancy at age 30, by level of educational attainment and gender. *Note*. Adapted from "Education at a glance: OECD indicators," by OCDE, 2012a. Copyright 2012 by OCDE.

analyze important relationships at the heart of our social life and our economy. Globalization also makes the involvement of international organizations in understanding and analyzing these relationships in the context of international comparisons more urgent, which allows sharing of national experiences and taking advantage of exemplary situations.

Notes :

[1] For more information on Education at a glance, see OCDE. (2014, June).

[2] A larger number of countries can be found in (OECD, 2011).

[3] Let's rather say that it is a "more" objective measure as it still relies on an informed ("honest") response of the interviewee..

[4] Only one exception would be the life expectancy slightly higher among American men with postsecondary education.

[5] See, for example, two chapters on healthy life expectancy in (OECD, 2012b).

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Statistics in the Service of Health

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The word statistics was first used to describe a set of aggregated data (commonly demographic observations, such as births and deaths), and later came to also denote the mathematical body of science that pertains to the collection, organization, analysis, interpretation, and presentation of data and uncertainty (Davidian & Louis, 2002; Dodge, 2006; Moses, 1986). For those interested in the historical developments in probability and statistics, there are many excellent books and reviews (Fienberg, 1992; Gigerenzer et al., 1989; Stigler, 1986). However, as John Tukey once said, "the best thing about being a statistician is that you get to play in everyone else's backyard" (Leonhardt, 2000). Yet, there has been little systematic work on the impact of the application of statistics in various scientific disciplines.

One of the earliest such applications was in demography: John Graunt's Bills of Mortality, a summary and analysis of births and deaths in 17th century England. Further statistical developments and applications came in astronomy (Pierre-Simon Laplace and Carl Friedrich Gauss), statistical thermodynamics (James Clerk Maxwell and Ludwig Boltzmann), quantum mechanics (Max Born), and the social sciences (Adolphe Quetelet), and later in genetics, evolutionary biology, agriculture, engineering, medicine, and economics. My objective in this review is rather modest: to discuss three historical examples when statistics (or rather, statistical principles and thinking) made a substantial contribution in advancing our understanding of health and disease.

Statistics and public health reform

Florence Nightingale was a British social reformer in 19th century England. When she was in her mid-thirties, she volunteered as a nurse during the Crimean War (September 1854 through September 1855), which was part of a wider conflict between Russia and an alliance of Britain, France, and the Ottoman Empire. Florence Nightingale arrived at the war theater in November 1854, and quickly compiled data on causes of deaths of soldiers that showed the predominance of non-battle related deaths. She attributed those deaths to lack of supplies and poor nutrition, ventilation, and sanitation, although she did not directly recognize their infectious nature.

Florence Nightingale was firmly in the camp of the miasma theory that held that many of the infectious killers of the time (cholera, typhus, dysentery) were due to environmental factors (decaying organic matter and noxious fumes) that were not passed between individuals but rather through "bad air" or "unhealthy fog." This thesis was favored by social progressives of the time, who placed on the state the responsibility to improve the environment and living conditions of the people. In contrast, the contagion theory held that disease was passed from person to person through physical contact, and was supported by many conservatives of the time who preferred to place the focus (if not the "blame") on individuals rather than the state. Pasteur's experiments and the eventual rise of the germ theory in the second half of the 19th century settled the matter and miasma was discredited, but not before it spurred a push for sanitation and hygiene, bringing about substantial public health gains.

But I digress. Florence Nightingale initially placed more emphasis on nutrition and lack of supplies, although she later also focused on the importance of living conditions. She arrived in Crimea in November 1854, and a Sanitary Commission followed her in March 1855. After she returned to Britain, her presentations to politicians and civil servants were very influential, and she was instrumental in the establishment of hospitals that were sanitary and had clean and fresh air. She was also a pioneer in the training of nurses and other medical personnel. Many of her presentations and campaigns relied on inventive use of statistical summaries and graphics, and she is considered one of the first individuals to put statistics to effective use in the service of public health and health policy. Figure 1 is one of her classic summaries of the causes of death in the army in Crimea, that relies on a polar area graph (also sometimes incorrectly called "coxcomb" diagram), a type of pie chart which is particularly useful in displaying cyclical patterns.

Statistics and the polio vaccine trials

By the middle of the 20th century, paralytic poliomyelitis (with about 25,000-40,000 cases per year in the US) had emerged as one of the most dreaded childhood illnesses. In 1952, John Salk developed the inactivated polio vaccine, and soon after, plans were put in motion for a huge field trial to test the vaccine among young schoolchildren (Blume & Geesink, 2000; Meldrum, 1998). The vaccine trial was sponsored by the National Foundation for Infantile Paralysis (NFIP, later renamed the March of Dimes) and its early design called for observed controls, i.e., injecting the vaccine to consenting children, and using unvaccinated children as controls. An independent Center was set up for the trial's implementation and evaluation under the direction of virologist Dr. Thomas Francis, Jr., who then convened an external advisory group to review the trial design and implementation. Within this group, the "clinicians" panel supported the original observed controls design, while the "statisticians" panel recommended a randomized placebo controls design (Meldrum, 1998). A third "health officers" panel was divided, with most members supporting the observed controls design, but a vocal minority (including those at the more respected health departments of Massachusetts, New York, Michigan, Ohio, Illinois, and California) arguing forcefully in favor of the placebo controls design (Meldrum, 1998). Consequently, with strong backing from Dr. Francis, members of the advisory group, and outside experts (including well-known statisticians, such as Jerome Cornfield, Felix Moore, and Paul Meier), a dual design was adopted: 127 test areas in 33 states used the observed control design (consenting second graders were vaccinated, no placebo was given, and all first and third graders were used as controls), while 84 test areas in 11 states used a blinded randomized design (consenting children in grades 1-3 received injections of either vaccine or placebo and were then compared). Within a few months (October 1953 to February 1954), the scientific focus had shifted from the observed controls to the randomized placebo controls, although statistician Kenneth Brownlee would subsequently label the observed controls part of the trial as "stupid and futile" and its results "worthless" (Brownlee, 1955, p.1007). It is interesting that, 10 years later, Brownlee found himself on the losing end of the controversy regarding smoking and lung cancer (see below). The polio trials were quickly conducted from April to June 1954, outcomes were assessed through December 1954, and results reported in April 1955 (Francis et al., 1955), an amazing feat, considering that about one and a half million schoolchildren were involved.

Table 1 summarizes the main trial results. The vaccine effectiveness can be estimated as 71% in the placebo control areas (vaccine vs. placebo groups), but only 62% in the observed control areas (vaccinated 2nd-graders vs. unvaccinated 1st- and 3rd-graders). The observed unvaccinated controls had substantially lower polio incidence than the randomized placebo controls, mainly because of complex selection (participation) biases, and statistician Paul Meier remarked that "[w]ere the observed control information alone available, considerable doubt would have remained about the proper interpretation of the results" (Meier, 1989, p.11).

Statistics and the link between cigarette smoking and lung cancer

In the early 1950s, the results of the first well-designed observational studies which suggested a strong causal association between cigarette smoking and lung cancer (Doll & Hill, 1952, 1954; Hammond & Horn, 1954) touched off a fierce debate that would last for two decades. Many (although not all) of the arguments were statistical in nature, and the fiercest early opponents of the causal link between smoking and lung cancer were famous statisticians. Joseph Berkson (1958) expressed conceptual and methodological reservations (including concerns about confounding by environmental factors, such as pollution), while Sir Ronald Fisher (1957) expressed doubts on the grounds of non-specificity of the smoking effects and favored a "constitutional" or "genetic" theory of causation (the idea that an unknown genetic factor predisposes individuals to smoking and is also involved in the causation of lung cancer).

At the same time, the list of supporters of the causal link between smoking and cancer also included prominent statisticians, such as Jerome Cornfield and Sir Austin Bradford Hill, and epidemiologists, such as William Haenszel and Sir Richard Doll. Cornfield et al. (1959) gave a particularly strong and comprehensive defense of the causal hypothesis, and by 1964, the Surgeon General's Report concluded that "[c]igarette smoking is a health hazard of sufficient importance in the United States to warrant appropriate remedial action" (U.S. Department of Health, Education, and Welfare, 1964, p.33). Skeptics, such as Kenneth Brownlee (1965), stubbornly kept up their objections, but within a few more years, serious scientific debate was effectively over, and various educational, policy, and legislative efforts to curb smoking were being initiated.

One reason for the balance eventually tilting in favor of the causal hypothesis was the cumulative effect of well-designed observational studies which controlled for increasingly more potential confounders and which established that the estimated smoking effects were quite consistent across variations in study designs, target populations, and measurements. A second reason was that biology caught up with epidemiology, finally elucidating the biological mechanisms of smoking's diverse health effects. Finally, the skeptics themselves failed to identify any specific confounders or genetic factors that would explain the observed association, and their generic arguments that such factors could exist became increasingly unconvincing.

Conclusions

The three examples I discussed in this paper illustrate the role that statistics has played at various points in time and under different circumstances. But I think that the broader importance of those stories may lie in their implications and consequences.

Statistics became the linchpin of public health and health policy, the randomized controlled trial was established as the gold standard for evaluation of interventions, treatments, and drugs, and observational studies were accepted as valid and useful tools in the study of disease causation.

In all three examples, there was no single statistical guru, no single statistical advance, no single statistical "smoking gun" that carried the day. It was no fancy technique or analysis, but rather, basic statistical principles and thinking that shaped the direction of the scientific research and set those precedents. Various scientists (biologists, physicians, social scientists) have the subject-matter knowledge. Statistics supplies the necessary statistical toolkits, but more importantly, it anchors an entire philosophy regarding ways to attack and solve the problem at hand. It may be that this latter broader contribution of statistics is the reason behind its ever expanding reach and impact in the health sciences during the last two centuries.

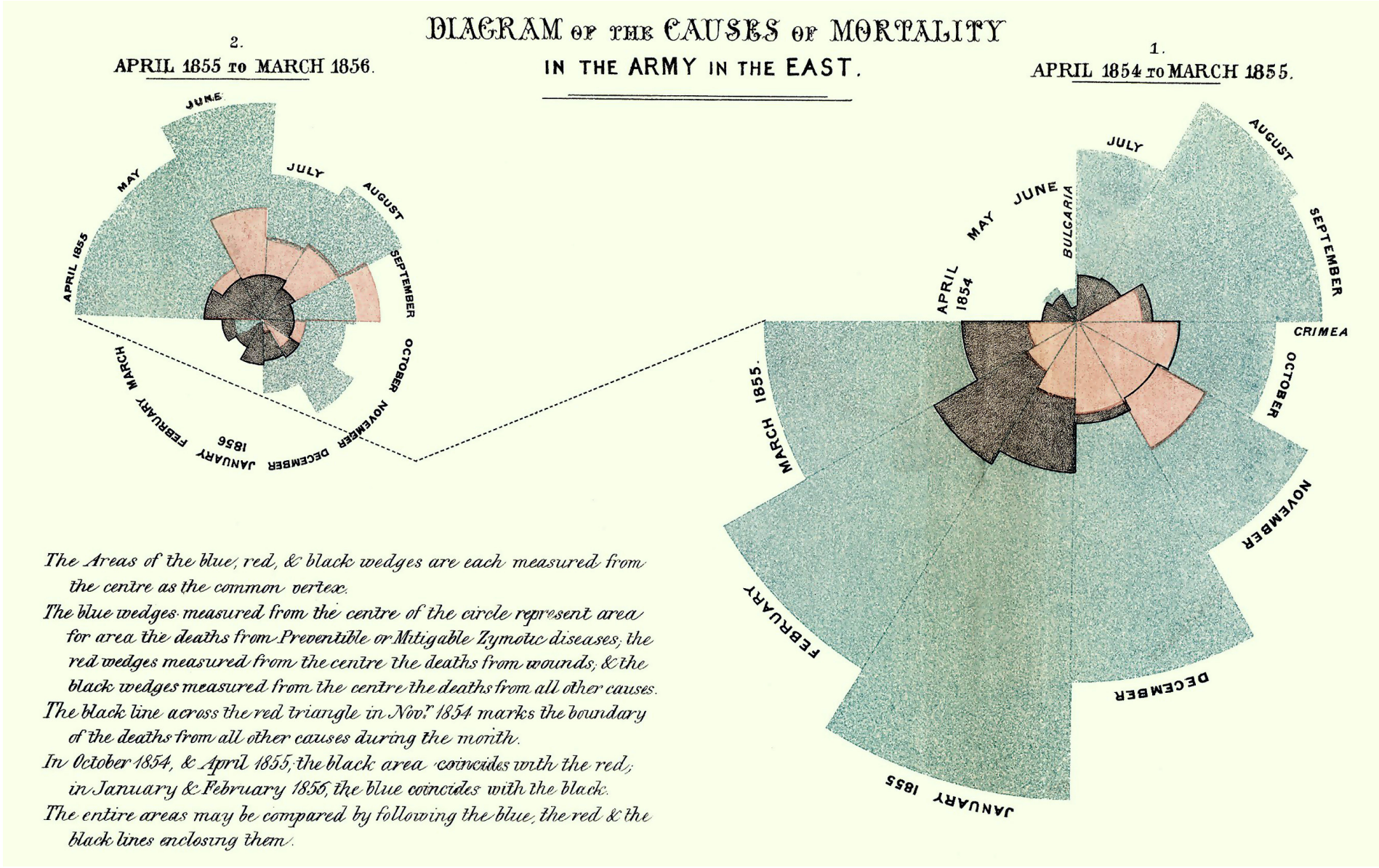
Table 1

Main results of the 1954 polyomyelitis vaccine trials. *Note*. Adapted from "An Evaluation of the 1954 Poliomyelitis Vaccine Trials: Summary Report," by T. Francis, Jr., R. Korns, R. Voight, M. Boisen, F. Hemphill, J. Napier, and E. Tolchinsky, 1955, *American Journal of Public Health*, 45(5, Pt. 2).

	Paralytic Polio		
	N	*n*	*Rate (per 100,000)*
Placebo controls trial			
Vaccine	200,745	33	16.4
Placebo	201,229	115	57.1
Not vaccinated (non-participants)	338,778	121	35.7
Observed controls trial			
Vaccinated (2nd grade)	221,998	38	17.1
Not vaccinated (2nd grade)	123,605	43	34.8
Not vaccinated (1st & 3rd grades)	725,173	330	45.5

Figure 1

Example of polar area graph drawn by Florence Nightingale, summarizing the number of deaths due to preventable diseases (in green), wounds (in orange), and other causes (in brown), during the Crimean War, 1854-1856. The graph was published in *Notes on Matters Affecting the Health, Efficiency, and Hospital Administration of the British Army* and sent to Queen Victoria in 1858.



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Parental and Peer Influences on Adolescent Smoking: A Literature Review

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Résumé :

(traduction)

La cigarette est largement acceptée comme un comportement négatif pour la santé, associé à de nombreux risques graves. Le tabagisme chez les adolescents est d'un intérêt particulier du point de vue de la santé publique, alors même que l'initiation au tabagisme à l'adolescence se trouve associée à des taux plus élevés de dépendance à l'âge adulte. Cette revue de la littérature examinera l'influence des réseaux de soutien social, en particulier les parents et les pairs, sur l'initiation au tabagisme et sur sa progression chez les adolescents. L'influence des réseaux de soutien social opère principalement à travers la théorie de l'apprentissage social, selon laquelle les adolescents imitent le comportement de ceux qui sont dans leur réseau social. La littérature suggère que, tandis que les parents ont plus d'influence chez les jeunes adolescents, les pairs deviennent la principale source d'influence chez les adolescents plus âgés, en raison de ces phénomènes bien connus que sont la sélection par les pairs et l'influence des pairs. Les parents peuvent influer positivement sur le comportement des adolescents face au tabagisme grâce à une communication efficace et au maintien d'une relation saine parent-enfant. Les pairs peuvent également influencer positivement le comportement des fumeurs par les mêmes mécanismes d'influence et de sélection par les pairs. La connaissance de la façon dont les parents et les pairs incitent les adolescents à commencer de fumer, et à continuer, peut aider à l'élaboration de programmes de santé publique qui ciblent ce comportement à haut risque.

Mots-clés : Adolescence, fumer, influence des pairs, sélection des pairs, influence parentale

Abstract:

Smoking cigarettes has been widely accepted as a negative health behaviour associated with many serious risks. Adolescent smoking is of particular interest from a public health perspective as the initiation of smoking in adolescence has been associated with higher addiction rates in adulthood. This review of the literature will examine the influence of social support networks, particularly parents and peers, on the initiation and escalation of adolescent smoking. The influence of social support networks primarily operates through the social learning theory, in which the adolescent mimics the behaviour of those in their social network. The literature suggests that while parents are more influential in young adolescence, peers become the main source of influence in later adolescence through processes known as peer selection and peer influence. Parents can positively affect adolescents' smoking behaviour through effective communication and maintenance of a healthy parent-child relationship. Peers can also positively influence smoking behaviour through the same mechanisms of peer influence and selection. Knowledge of how parents and peers influence adolescent smoking initiation and escalation can potentially assist in developing public health programming that targets this high-risk behaviour.

Keywords: Adolescence, smoking, peer influence, peer selection, parental influence

Smoking cigarettes has become widely acknowledged as a behaviour that entails many serious health risks. Numerous bylaws, retail protocols, and public health initiatives have attempted to prevent the initiation of smoking in adolescents specifically. According to Statistics Canada, the rate of smoking among Canadian adolescents has shown greater reduction than that of any other age group between 2001 and 2011 (Janz, 2012). Smoking rates among men aged 18-19 have declined by 13.4%, while males aged 15-17 have demonstrated a decline in smoking by 9.2%. Female statistics depict a similar trend, with ages 18-19 and 15-17 to declining by 15.7% and 13.6%, respectively. These statistics emphasize the progress in adolescent smoking rates; however, cigarette use remains a critical issue because in 2011, the overall smoking rate in adolescents was still as high as 20% (Janz, 2012).

In a longitudinal study by Griffin, Botvin, Doyle, Diaz, and Epstein (1999), findings indicated an association between smoking association in adolescence and addiction in adulthood, thus reinforcing the importance of health promotion strategies targeting this age group. The influence of parental and peer relationships has been a main focus of research on adolescent smoking, generally supporting the social learning theory that adolescents imitate behaviours of others in their social environment (Bandura & Davidson Films Inc., 2003). Akers and Lee (1996) suggest that behaviours such as smoking are commonly initiated through the processes of the social learning theory such as observation, interaction, reinforcement, and attitudes toward deviant others (in this case, parents and peers). Further, understanding how parental and peer factors influence the initiation of adolescent smoking through a critical review of the literature will potentially enable the development of public health programming which targets not only smoking adolescents but also their families and peers. Important theories from the literature include parental behaviour, communication, and expectations, the power of peer influence, and peer selection in the initiation and prevention of adolescent smoking.

The databases Scholars Portal, PsycARTICLES, and SAGE Premier 2014 were used to locate articles of interest. Only Canadian and American studies were included in the review due to cultural differences surrounding smoking behaviour (World Health Organization, 2014).

Literature examining the influence of parental smoking on the initiation of smoking in adolescence supports the social learning theory. For example, Cole, Leatherdale, and Burkhalter (2013) surveyed 31,396 Canadian secondary school students and found that a parent smoking was highly predictive of adolescent daily smoking (75.7% of daily smokers had a parent, step-parent, or guardian that smoked). This supports a nine-year longitudinal study by Peterson and colleagues (2006) reporting a positive correlation between witnessing parental smoking in the third grade and behavioural acquisition of smoking by twelfth grade. These results conclude that having at least one parent that smokes significantly increased the risk of the adolescent becoming a daily smoker compared to families in which neither parent smoked. Janz (2012) reported that adolescents aged 15-17 were three times more likely to smoke if someone in their household was a regular smoker. Although these statistics support the social learning theory, it is not clear if this finding is due to parental influence specifically, as it could be related to the smoking habits of a sibling or extended family member living in the household.

Parental smoking behaviour has also been found to influence adolescent smoking transitions (for example, an irregular smoker becoming a regular smoker). Bricker and colleagues (2006) surveyed 5520 American families and found that parental smoking is associated with a high probability of adolescent experimentation with smoking, as well as transitioning from monthly smoking to daily smoking. While these studies present a strong case for the negative impact of parental smoking across the span of adolescence, other research supports differing degrees of parental influence throughout adolescence.

Vitaro, Wanner, Brendgen, Gosselin, and Gendreau (2004) attempt to explain the discrepancy between parental smoking behaviours and those of peers in a four-year longitudinal study of 812 preadolescents. Their findings suggest that parental smoking is a predictor of adolescent smoking initiation only if the adolescent begins smoking between the ages of 11 and 13; after this age, the influence of parents significantly decreases and that of peers becomes more important. Despite this change in influence over time, parental smoking remains an important influence on the smoking initiation of adolescents (Vitaro et al., 2004).

Parental influence on adolescent smoking initiation extends beyond tobacco use, as various studies suggest that specific components of the parent-adolescent relationship also have an impact on adolescent smoking. For example, Miller and Volk (2002) examined multiple aspects of family relationships among over a seven-year period, and found that a lack of time spent with family, infrequent engage-

ment in family activities, and a perceived lack of importance of the parent-child relationship were predictive of daily smoking in the adolescent. Scal, Ireland, and Borowsky (2003) have supported this association, reporting that family-connectedness serves as a protective factor against smoking initiation. Feeling understood, cared for, and satisfied with family relationships were associated with a lower risk of smoking initiation throughout development (Scal, Ireland, & Borowsky, 2003).

The parent-child relationship has been further examined in studies that analyzed the association between parent-child communication and adolescent smoking behaviours (Metzger et al., 2013; Simons-Morton, 2004; Simons-Morton, Haynie, Crump, Eitel, & Saylor, 2001). An example of this relationship was apparent in a longitudinal study by Metzger and colleagues (2013), which demonstrated that mothers with low tolerance for the subject of smoking and strict rules regarding the use of cigarettes had adolescents who were more likely to engage in active secrecy when communicating with their mothers (hiding their actual smoking behaviours from their mother in conversation). Engaging in active secrecy in parent-solicited conversations surrounding smoking is in turn associated with an escalation of cigarette use over a two-year period.

Other studies, however, have shown that effective smoking communication can have a protective effect on adolescenets. For example, a study by Simons-Morton (2004) examined the protective effects of parental expectations about adolescent smoking initiation through a survey of 1267 students at the beginning of sixth grade and again at the end of seventh grade. Their results suggest that parental expectations for their child to not smoke was the most protective factor in onset of adolescent smoking across the entire time span of the study. Although most parents likely hope that their adolescents will not smoke, it is the parents who communicate this desire effectively that are successful in providing the protective mechanism (Simons-Morton et al., 2001). Simons-Morton and colleagues (2001) have described that authoritative parenting, which is high in demandingness and responsiveness, fosters these protective expectations and effective communication styles. Knowledge of how parents influence adolescent smoking through relationship dynamics is a crucial component in developing effective public health programs as it emphasizes the importance of targeting the family unit in anti-smoking initiatives.

Parents are not the only factor influencing whether or not adolescents choose to smoke. The effect of peers on adolescent behaviour is of interest due to the large amount of time adolescents spend in contact with their peers in and outside of school (Barnes, Hoffman, Farrell, & Dintcheff, 2007). Peer influence constitutes an adolescent being influenced or 'pressured' to smoke with the intention of identifying more with peers. (Hoffman, Monge, Chou, & Valente, 2007). Maxwell (2002) demonstrated a strong peer influence in the domain of cigarette smoking through a longitudinal study of 1969 adolescents, providing evidence that a same sex friend engaging in smoking behaviour at the first data collection was associated with the initiation of the same behaviour in the adolescent at the second data collection. In fact, the likelihood of the adolescents in this study engaging in the behaviour was 1.9 times higher than that of an adolescent without a same sex, smoking friend.

As previously discussed, the influence of peers increases as adolescents get older. At ages 12-13, witnessing parents and friends smoking are equally predictive of adolescent smoking; however, between at ages 13-14, the peer group was the highest predictor in smoking initiation (Vitaro et al., 2004).

A study by Harakeh and Vollebergh (2012) distinguished Hoffman and colleagues' (2007) definition of peer influence into two domains: active and passive. Imitation of peers' smoking in order to belong was termed passive peer influence, where as peer pressuring another into smoking was termed active peer influence. In a sample of 68 older adolescents and young adults, peer smoking was predictive of the total number of cigarettes smoked by the participants while peer pressure was not. This study demonstrates the importance of imitation or passive peer influence in accordance with the social learning theory.

While peer influence appears to play a crucial role in adolescent smoking initiation, academics have differentiated between peer influence and peer selection, and it is suggested that the latter may be more significant concerning tobacco use. While peer influence involves an adolescent being pressured or influenced by friends into smoking, peer selection is defined as the selection of friends based on their existing smoking status (Ennett & Bauman, 1994). Hoffman and colleagues (2007) studied smoking behaviours in 20,747 adolescents and compared them to the smoking behaviours of their peers on two separate occasions. Questionnaires inquired about adolescents' smoking habits and the smoking habits of their self-defined three best friends. Findings indicated evidence of peer selection due to smoking at the first time-point being associated with friends smoking at the second time-point.

Hall and Valente (2007) have provided further evidence of the critical effect of peer selection by conducting a survey on personal smoking behaviour and that of five best friends in 1960 adolescents at two time-points. Peer selection was evident when participants nominated smokers as friends at the first time-point, as this was predictive of smoking at the second time-point. For example, students were more susceptible to smoking in grade seven if they chose smokers as friends in grade six (AOR=20.27, $p<0.05$) (Hall & Valente, 2007). Cole and colleagues (2013) used data from the 2010/2011 Canadian Youth Smoking Survey to demonstrate the association between adolescents' their friends' smoking behaviours: 72.1% of regular adolescent smokers reported that five or more of their closest friends also smoke cigarettes. Although this study supports other findings (Hall & Valente, 2007; Hoffman et al., 2007), one study design limitation is the cross-sectional methodology, which renders it unclear if the effects observed were due to peer influence or peer selection.

Despite the negative impact that peer relationships can have on adolescent behaviour, there are also protective benefits that can arise from these relationships. Hall and Valente (2007) demonstrated that smokers' influence in sixth grade negatively predicted smoking in seventh grade. This effect was present when a smoker nominated a non-smoker as a friend, but the non-smoker did not reciprocate the nomination. This decreased the non-smoker's chances of smoking by keeping his or her friend group free from the influence of smokers.

It has also been found that adolescents are more likely to deter smoking among their friends than they are to promote it. Brady, Morrell, Song, and Halpern-Felsher (2013) found that approximately 70% of 'ever-smokers' had deterred smoking to a friend, compared to only 45% that had promoted it. Non-smokers were even less likely to encourage smoking, with only 5% of 'never-smokers' promoting it and 40% actively deterring it. This demonstrates that although peer influence is often assumed to be negative in nature, peers also have the capacity to provide positive influence on health behaviour and this aspect should be considered when planning public health initiatives.

Research concerning parental and peer influences on smoking initiation and escalation in adolescents can help public health programs target the prevention and cessation of adolescent smoking. However, current research possesses many limitations that must be considered when interpreting the findings. A major limitation to studying smoking behaviour is the inconsistency of how smoking is defined. Cole and colleagues (2013) used data from the Canadian Youth Smoking Survey in their research of smoking patterns among youth. For this survey, "current smoking status was measured by asking respondents if they have ever smoked 100 or more cigarettes in their lifetime, and on how many of the last 30 days they smoked one or more cigarettes" (Cole et al., 2013, p. 1611). In order to be classified as a current daily smoker, adolescents had to have smoked both 100 cigarettes in their lifetime, and one cigarette per day for the last 30 days. It could be argued that these qualifications are quite arbitrary, and many adolescents may be unsure if the number of cigarettes they have smoked falls above or below 100. Other studies have identified adolescents as smokers based on how many times they have tried even one puff of a cigarette (Hall & Valente, 2007; Hoffman et al., 2007; Simons-Morton, 2004). This definition is practical in the sense that it accounts for all adolescents that have tried smoking; however, it does not differentiate between the separate behaviours of daily smoking and trying smoking once due to peer pressure or other external forces. Vitaro and colleagues (2004) defined smoking by measuring the number of cigarettes smoked during the week and the day before data collection, which is also limited. If data collection were to take place mid-week, this measure does not account for cigarettes that may be smoked predominantly on weekends when adolescents are engaging in social smoking. This study also required adolescents to report on the smoking behaviour of their parents as occasional, regular, or very often (Vitaro et al., 2004). This is a fairly subjective measure as some adolescents may view 'very often' as a pack of cigarettes a day, while others may view this as one or two cigarettes per day. For future research it is recommended that a consistent measure of smoking behaviour be implemented, including objective numbers differentiating cigarettes smoked by one-time, occasional, and daily smokers.

A second limitation of the research surrounding adolescent smoking is that the majority of data is collected using surveys in the classroom setting. Although participants are guaranteed that their information will be kept confidential, there is still a chance of social desirability bias occurring as smoking is generally viewed as a negative health behaviour. Another type of bias appears in these surveys when adolescents are asked to report the smoking behaviour of their friends, such as in the study by Hoffman and colleagues (2007). Again, there is bias in this measure as smoking adolescents are more likely to report that their friends smoke, regardless of friends' actual smoking prevalence

(Urberg, Shiang-Jeou, & Liang, 1990). A better method of measuring friends' smoking behaviour is matching friendship nominations within the group, as was done by Hall and Valente (2007).

Limitations also exist in the methodology of the present literature review. Parental and peer influence on smoking in adolescence is a heavily researched topic, thus it is possible that many important study findings were excluded from the literature review. For example, despite cultural implications, the many European studies on this topic may still lend valuable information. It may also be beneficial to include sibling influence in the discussion of adolescent smoking initiation, as other household members may impact adolescents (Janz, 2012).

The prevalence of adolescent smoking continues to decline (Janz, 2012); however, the high risk associated with adolescent smoking initiation highlights this behaviour for targeting by various public health campaigns. Parents and peers both have influential effects on adolescents' smoking behaviour, predominantly through the social learning theory. Parents' smoking has been found to be a predictor of adolescents' smoking, especially between ages 11-13 (Vitaro et al., 2004). Parents can also have a protective effect on adolescents by fostering valued and connected family relationships, as well as ensuring clear communication of expectations in regard to cigarette smoking. Peers can impact adolescents through both peer influence and peer selection. Having a same sex friend that smokes has been correlated with smoking in adolescents, especially at the age of 12 and older (Vitaro et al., 2004). Evidence of peer selection is also clear, as adolescents that smoke or want to smoke are likely to choose friends that also smoke. Despite these negative effects of peer influence, peers can also provide a protective effect over adolescents by deterring them from smoking. It is recommended that further research in this area implements a standard definition of smoking behaviour as well as the use of alternate data collection methods that limit bias. This will enhance the accuracy of findings and thus meaningfully contribute to the development of public health initiatives. It is also recommended that this acquired knowledge of how the social learning theory influences adolescent smoking initiation is used to incorporate families and peers into health promotion programs, and thus help approach the goal of preventing adolescent smoking initiation and promoting adolescent smoking cessation.

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Human Health Effects of Dietary Aluminum

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Résumé :

(traduction)

On retrouve l'aluminium en abondance dans l'environnement : on en trouve notamment dans la plupart des aliments. À ce jour, il n'y a pas d'ensemble de données suffisamment convaincant pour nous renseigner sur les risques pour la santé lié à l'ingestion d'aluminium à travers la nourriture, l'eau et les produits pharmaceutiques. Cet article cherche à examiner l'ensemble de la littérature existante sur le sujet en quête de données sur les effets de l'absorption d'aluminium dans l'alimentation sur la santé.

Notre revue de littérature démontre que les données existantes sont contradictoires et, qu'en tant que tel, on ne peut établir de lien de causalité entre l'aluminium ingéré par l'alimentation et des effets néfastes sur la santé. De nombreuses études suggèrent une relation entre la consommation d'aluminium et la maladie d'Alzheimer, mais là encore les résultats sont contradictoires. Des recherches supplémentaires sont nécessaires pour établir le risque lié à l'ingestion quotidienne d'aluminium par l'alimentation, l'eau et l'utilisation de produits pharmaceutiques. Les recherches futures devraient être menées sur des groupes plus sensibles au sein de la population comme les enfants et les consommateurs chroniques de produits pharmaceutique.

Mots-clés :

Aluminium, régime alimentaire, absorption, maladie d'Alzheimer, maladie de Parkinson

Abstract:

Aluminum is abundant in the environment and can also be found in most foods. To date, no convincing data has been found regarding the possible risk of ingesting aluminum through food, water and pharmaceuticals. This paper sought to review current literature to find evidence of the health effects of aluminum absorption in the diet in humans.

The review found that the evidence is contradictory and as such, there is no established causation between dietary aluminum and adverse health effects. Many studies suggest a relationship between aluminum consumption and Alzheimer's disease, but here again, the results are inconsistent. More research is needed to establish the risk of daily ingestion of aluminum through the diet, drinking water and the use of pharmaceuticals. Further research should be conducted on subpopulation groups, such as children, chronic pharmaceutical drug users and other vulnerable groups.

Keywords:

Aluminum, diet, absorption, Alzheimer's disease, Parkinson's disease

Introduction

When considering the health of an individual, it is important to include the external environment as it can have a large impact on their diet, activity, and exposure. Many metals and elements are present in the environment and make contact with humans during day-to-day life. These metals and elements can interact with the human body through various intake methods and sometimes negatively impact their health. One of the most abundant metals on Earth is aluminum (Encyclopedia of Earth, 2008), which accounts for 8% of the earth's crust (Health Canada, 1998). Aluminum has been shown to enter the human body predominantly through the oral route, as it is present in food, food additives, pharmaceuticals, utensils, and water (Greger & Sutherland, 1997).

Many studies have been conducted to assess the potential harmful health effects of daily ingestion of aluminum in humans. To date, aluminum has been linked to neurological and bone abnormalities (Greger & Sutherland, 1997), Alzheimer's and Parkinson's diseases (Greger, 1993), and cognitive impairments (Krewski et al., 2007). Furthermore, the process of 'Aluminum production' has received recent carcinogenic classification by the International Agency for Research on Cancer (IARC) (Krewski et al., 2007). Although most of these researchers have failed to demonstrate a robust link or cause, there is still concern regarding the effects of long-term aluminum exposure, especially to those individuals who consume more than the average quantity through their pharmaceutical regimens. This paper will outline the key findings in studies on dietary aluminum consumption to determine the human health effects of dietary aluminum and to establish whether it is a serious concern for humans. Firstly, absorption and distribution of orally ingested aluminum will be elaborated upon, and subsequently the human health effects will be explored.

Exposure

Orally ingested aluminum sources include food products, food additives, utensils and packaging items, water, and pharmaceuticals (Greger & Sutherland, 1997). Aluminum has been found in small quantities (i.e.: under 0.2 mg) in most foods (Greger & Sutherland, 1997). Certain plants such as tea leaves, however, accumulate more than 100 µg Al/g. This aluminum is often non-soluble, and therefore thought to be less of a concern for human health as the body does not as readily absorb it (Greger & Sutherland, 1997). According to certain American studies, the average adult consumes between 2-25 mg of dietary aluminum daily (Greger, 1993). Moreover, aluminum is present in food additives such as baking powder or flour, as aluminum compounds are sometimes used as pH adjusting agents (Krewski et al., 2007). A certain amount of aluminum is also present in utensils and packaging of foods such as cans. This is significant because, as described by Greger and Sutherland, "acidic foods cooked for long periods of time in aluminum pans can accumulate as much as 17 mg of aluminum in a 100 g serving" (Greger & Sutherland, 1997, p.441).

Water is another source of aluminum consumption, accounting for 5% of the total daily intake for the average adult (Health Canada, 2003). The presence of aluminum in drinking water is attributable to both suboptimal water purification techniques and excess natural occurrence (Becaria, Campbell, & Bondy, 2002). In Canada, water treatment plants use mostly aluminum sulphate compounds, although adequate water treatment should result in negligible amounts in the final drinking water. They are used "as coagulants to reduce organic matter, colour, turbidity, and microorganism levels" (World Health Organization, 2003). In addition to total concentration in water, solubility can affect the final plasma concentration of aluminum in someone exposed to it. The pH appears to be the most important factor aluminum solubility in water, as shown in Figure 1 (see Appendix). Both low and high pH levels encourage aluminum dissolution, increasing its absorption potential once in contact with humans (Agriculture and Agri-Food Canada, 2001).

The third known method of aluminum ingestion for humans is through pharmaceuticals. Aluminum is found in calcium supplements, sucralfate (an anti-ulcer agent), buffered aspirin, and aluminum-based phosphate binders. The latter can lead to the absorption of 10 g of aluminum per day when used by people with reduced renal function (Greger & Sutherland, 1997).

Absorption, Distribution, Metabolism, and Excretion

Considering these oral methods of aluminum entry into the human body, only about 1% of the aluminum ingested from food gets absorbed (Greger & Sutherland, 1997). Various factors intervene in the absorption process and much re-

mains unclear, requiring further research. It is known that the aluminum present in drinking water is more readily absorbed, though as mentioned earlier, it counts for a much lower amount (5%) of the daily intake compared to food (95%) (Health Canada, 2003). Within the body, factors such as the type of aluminum compound being ingested, the food itself, and the age and health status of the individual ingesting the items, specifically his or her kidney function, all account for the differing levels of absorption of aluminum (Health Canada, 2003). Certain studies have identified increased intestinal absorption in the elderly and immunocompromised individuals, leading to concerns about toxicity in these populations (Agriculture and Agri-Food Canada, 2001).

Aluminum may share absorptive pathways with calcium (Greger & Sutherland, 1997). A study by Cochran, Goddard, and Ludwigson (1990) on rats showed a small decrease in aluminum uptake in the presence of calcium channel blockers (Greger, 1993). However, their findings state that due to high levels of verapamil, a calcium-channel blocking agent used in their study, "the small reduction in rate of Al uptake which we observed cannot confidently be ascribed to direct closure of calcium channels to Al" (Cochran et al., 1990, p.293). This study did confirm, however, that aluminum uptake is energy dependant (Cochran et al., 1990). There is evidence that citric acid may also affect aluminum absorption. In patients taking citrate-containing pharmaceuticals concurrently with aluminum-containing pharmaceuticals, higher levels of urine and serum aluminum were detected (Greger, 1993). Three reasons are suggested by Greger to explain this increased absorption: firstly, citrate may increase the solubility of aluminum in the gut, making it easy to absorb; secondly, citrate may serve to co-transport aluminum into mucosal cells; and lastly, citrate may open epithelial tight junctions, allowing aluminum to pass out of the intestinal lumen (Greger, 1993).

The distribution of aluminum is better understood as accumulating mostly in bones and lungs (Krewski et al., 2007). Other affected areas are soft tissues (usually after intravenous fluid contamination), the spleen, liver, kidney, nervous tissues, muscles, and the heart (Greger, 1993). For orally ingested aluminum, however, the tissues mostly affected are the bones, liver and the blood itself (Greger, 1993). Once aluminum has entered the body, the mechanism by which it is metabolised is still not fully known. The routes of excretion are mostly from the kidneys, which accounts for 95% of elimination, and bile (Krewski et al., 2007). In short, much on the mechanism of aluminum pharmacokinetics in humans is unknown and there is a need for more research to be conducted in this field in order to better understand the compound's potential to affect human health.

Human Health Effects

Many human health effects that have been associated with aluminum are due to intravenous contamination. The most important health effect is dialysis encephalopathy, which can lead to tremors, convulsions, psychosis, and other related neurological problems (Health Canada, 2003). In addition, as previously mentioned occupational aluminum exposure has been shown to have carcinogenic effects. This paper will focus instead on the negative impacts linked to dietary aluminum, although these links have not yet been fully established. Health Canada's Review of Dietary Exposure to Aluminum states that "recent Canadian data suggests that current average aluminum intake through food does not pose an unacceptable health risk to Canadians" (Health Canada, 2008, p.3). The review goes on to state that despite the current status, many studies being conducted currently are showing results of adverse health effects in humans and animals with long-term aluminum exposure (Health Canada, 2008). This delay in conclusive results underlines the difficulty of regulating food and products and creating policies to protect citizens, as the federal government must have reasonable proof before it can act to restrict sales or consumption of a certain product but in waiting for this proof may be increasing the risk of toxicity in its citizens.

The many current contradictory studies make it difficult to assess whether there is sufficient evidence to establish that aluminum is unsafe for regular dietary consumption. A paper published by Yokel (1988) discussed the association between Alzheimer's disease (AD) and aluminum. Though the cause for AD is still unknown, this paper suggested that because the adverse human health effects of aluminum toxicity and the disease were similar (in that they both led to progressive central nervous system deterioration and dementia), there was possibly a link between the two conditions (Yokel, 1988). A Canadian paper published by McLachlan in 1995 clarifies that the relationship between aluminum and AD is not one of causation, but rather that "aluminum is a factor which promotes the expression of the dementia of AD, rather than the root cause of the di-

sease" (McLachlan, 1995, p.235). In 2002, another paper suggested that the disparities in the results regarding AD and aluminum toxicity may be due to methodology; specifically, in terms of how and where aluminum levels are measured in the body and how the data may be masked when analyzing bulk brain tissue in senile dementia patients (Becaria et al., 2002). Walton, in his paper published in 2009, shows a summary of 14 recent studies on the association between AD and aluminum content in drinking water (Walton, 2009a). Thirteen of these studies overlapped with a systematic review published by Flaten in 2001, which assessed aluminum as a risk factor for AD, and of these nine showed statistically significant positive relationships between aluminum content in drinking water and AD (Flaten, 2001). One of the studies from Walton's review, published in 1996, was conducted in Canada and found a significant risk of AD development associated with exposure to residential drinking water with an aluminum content of ≥100 µg/L (Becaria et al., 2002). Although ten reviewed studies in total showed statistically significant positive relationships, the other four found "no effect" (Walton, 2009a, p.1059). This emphasizes the inconsistent findings relating to risks of aluminum consumption in drinking water for humans. In more recent years, other health effects have similarly been linked to the intake of aluminum. Systematic reviews, which represent the highest methodological validity among scientific research, are important in establishing credible evidence around such uncertain relationships, and as more research is done additional reviews should be conducted.

Walton conducted another study in 2009, where three groups of young rats were fed diets containing low, intermediate, or high levels of aluminum reflecting the average human proportional consumption. They were then tested near end-of-life to determine their memory function. Rats with intermediate to high aluminum diets obtained lower memory test scores and had higher serum aluminum concentrations than those fed low aluminum diets (Walton, 2009b). Other studies have tested rats for different neurological effects, with one suggesting enhanced lipid peroxidation after aluminum exposure (Savory, Rao, Huang, Letada, & Hernam, 1999), and another showing impaired brain glucose utilization after aluminum exposure (Cho & Joshi, 1988). Additionally, aluminum has been linked to reproductive toxicities, where a mouse study showed that after three generations of consumption of aluminum-containing drinking water, second and third generation offspring had growth retardation (Ondreicka, Ginter, & Kortus, 1966).

Parenteral Nutrition

Although parenteral nutrition is not an oral route of aluminum ingestion, it does act as an alternative dietary method for patients with dysfunctional gastrointestinal tracts. Consequently, the health effects linked to aluminum exposure via this type of treatment will be explored further. In 1992, a study showed that people receiving parenteral nutrition had higher average plasma aluminum concentrations (0.59 µM) than those that did not receive such treatment (0.33 µM) (Bougle, Bureau, Voirin, Neuville, & Duhamel, 1992). Additionally, the concentration of aluminum in serum was higher in newborns receiving parenteral nutrition (37 µg/L) than those who were not (5.2 µg/L) (Sedman et al., 1985). Studies conducted in this field showed that the then typical solution of casein hydrolysate contained more aluminum than similar lipid solutions (Yokel, 1988), resulting in practice changes by many institutions. As a result of these findings, many governments also set limits for the quantity of aluminum in parenteral solutions. For example, in the United States the U.S. Food and Drug Administration permits a maximum of 25 µg Al/L in large volume parenterals (Bougle et al., 1992).

The adverse health effects linked to parenteral nutrition contaminated with aluminum are elevated stainable bone aluminum and osteomalacia (Ott et al., 1983). In rats, parenteral nutrition formula containing aluminum led to an accumulation of the element in the liver and portal inflammation causing hepatobiliary dysfunction (Demircan et al., 1998). Of the population at risk for adverse health effects relating to this alternative form of feeding, neonates are especially susceptible due to their lower ability to excrete aluminum, and should thus be a focus of research to understand more about aluminum's pharmacokinetics and dynamics (Willhite et al., 2012).

Conclusion

Much of the information from studies concerning human health effects of dietary aluminum is contradictory or only shows a possible link, and there is currently no established proof of interaction or causation. Part of the reason for this lack of research is the ethical dilemma of human testing. Many studies have been conducted on animals for this reason, as it can be scientifically relevant to not only monitor but manipulate aluminum exposure throughout life. Until more evidence can be found regarding aluminum's possible toxic effects on human health, its consumption should

be kept to a minimum. This is especially logical as there is no risk associated with aluminum deficiency; as Greger describes, "no conclusive evidence suggests that aluminum is essential for growth, reproduction, or survival of humans or animals" - and therefore it should be removed from our diet, pharmaceuticals and food additives (Greger, 1993, p. 56). Supplementary research should also be conducted in subpopulations such as children, patients taking antacids or other aluminum-containing pharmaceutical drugs daily, patients with reduced renal functions, and patients on parenteral nutrition regimens to see if these groups might have a greater risk of suffering from adverse health effects.

Considering the multiple studies showing a link between aluminum consumption in drinking water and AD, further extensive research should be completed on this topic as well. It may also be important for the Canadian and other federal governments to consider an alternative aluminum salt-based water treatments, seeing as their safety has not been reasonably established. In short, dietary aluminum is a human health concern in today's society as it is omnipresent in our daily lives, and many studies have found it to be a risk to neurological, bone and reproductive health. Until we can be sure that these studies' findings were false or showed correlation but not causation, aluminum should not be considered a safe metal to ingest and Canadian policies should reflect this.

Appendix

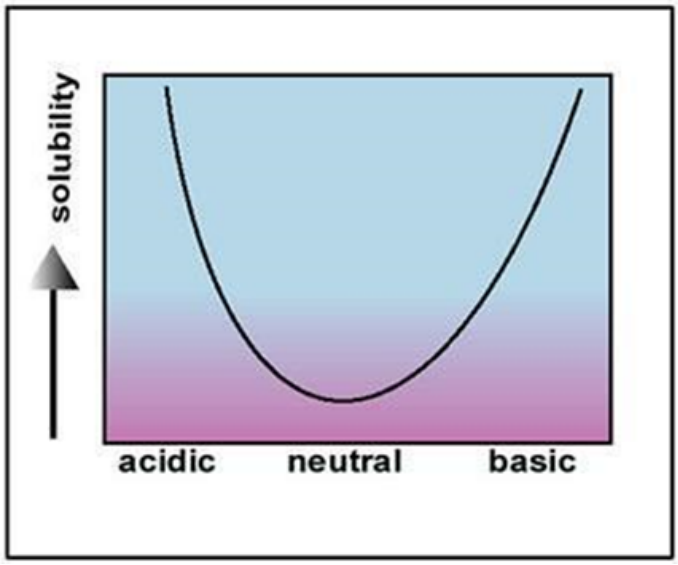

Figure 1 Solubility of aluminum in water according to pH level (Agriculture and Agri-Food Canada, 2001).

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The Epidemiology of Ophthalmological Disease among School Age Children in Rural India

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Résumé :

(traduction)

La cécité est l'une des premières préoccupations de santé publique en Inde rurale. Pourtant on sait très peu de choses au sujet de la prévalence des maladies oculaires chez les enfants d'âge scolaire en Inde. La base de données cliniques de l'institut d'ophtalmologie de Srikiran, qui décrit les visites des cliniciens dans les écoles de Kakinada , a été analysée rétrospectivement, pour déterminer la prévalence des maladies oculaires chez 8488 étudiants âgés de 18 ans et moins. Parmi les maladies diagnostiquées, on trouve l'impact réfractaire de base (comprenant plusieurs niveaux d'astigmatisme) comme étant la maladie la plus fréquente, suivie par le strabisme. Chez aucun des sujets testés, la carence en vitamine A n'est un facteur ayant contribué aux maladies oculaires.

Mots-clés : Épidémiologie, ophtalmologie, cécité, enfants, santé internationale, Inde

Abstract:

Preventable blindness is one of the primary health concerns in rural India, yet little is known about the prevalence of eye disease among India's school-aged children. The clinical database of the Srikiran Institute of Ophthalmology, which describes clinicians' visits to schools in Kakinada, India, was analyzed retrospectively to determine the prevalence of eye disease among 8488 students aged 18 years and younger. Among diagnosed illnesses, basic refractory impingement (including degrees of astigmatism) was the most common, followed by squinting. Vitamin A deficiency was not a factor in any of the tested subjects.

Keywords: Epidemiology, Ophthalmology, Blindness, Children, International health, India

Introduction

The southern Indian state of Andhra Pradesh has an official population of 76.2 million, representing 7% of all Indians who experience slightly lower total and female literacy rates than the national average (Ministry of Health and Family Welfare, 2011). Further, Andhra Pradesh is home to 7% of India's "scheduled" or low caste people (Ministry of Health and Family Welfare, 2011). A study of vision deficit in this area was performed by the LV Prasad Eye Institute in 2001 (Dandona & Dandona, 2001), as part of the World Health Organization's (WHO) VISION 2020 international initiative to contextualize visual impairment as an international public health issue. The WHO estimated that there were 18.7 million blind people in India in 2001, a number projected to grow to 24.1 million by 2010. This is an underestimate in comparison with other studies that suggest that almost 4 million Indians go blind every year as a result of cataracts alone (Singh, Garner, & Floyd, 2000). The comparative depth and rigor of the former study however, suggests that the WHO's VISION 2020 estimate is the most accurate.

Regardless of the disparity in estimates, it is clear that impaired vision is a serious issue in this region. Comprehension and action on this issue are impeded by a general lack of information on the distribution and epidemiology of eye disease in rural India. This is especially true for children, who are rarely the subjects of ophthalmological study. Causes of visual impairment include injury, nutritional deficit, lack of protection against UV rays, and strain due to fine acuity needs. Currently, the extent to which eye disease manifests earlier in life is unknown due to the paucity of investigation in this population.

In the present study, we used a clinical database from an ophthalmological hospital in Kakinada, India, to identify major diagnosable issues experienced by Indian school-aged children. Our intent was to estimate the extent of ophthalmic disease burden in this specific population and to describe and quantify the relationships between disease presentation and demographic characteristics.

Methods

Clinical and administrative data from the Srikiran Institute of Ophthalmology in Kakinada, India, were obtained for the period from 2003 to 2010. This data describes visits by clinic staff to local public schools, where students (aged 18 years and younger) were screened for basic, diagnosable eye disease. The data also describes the students' treatment regimens and outcomes and refers to a single school visit per child.

Descriptive statistics were employed to determine disease prevalence. Bivariate statistical analyses (chi square and independent samples t-tests) were used to explore relationships between clinical and demographic measures. These tests were deemed appropriate due to the normal distributions (of continuous variables) and large cell sizes (for discrete variables), as well as the dichotomous nature of the outcome diagnosis variable, which was coded as either disease presence or absence.

Permission for this study was granted by the Research Ethics office of the University of Ottawa.

Results

Within the dataset, there were a total of 8488 students 18 years old and younger, of whom 4299 (50.6%) were male and 4189 (49.4%) female. The age of the students was normally distributed (confirmed through examination of measurements of central tendency), with 729 (8.6%) aged from 0 – 6 years, 4920 (58%) aged 7 – 12 years, and the remaining 2839 (33.4%) aged 13 – 18 years.

Upon examination, 4774 (56.2%) students were found to have no diagnosed eye disease. Among the 43.8% with a positive diagnosis, the most common issues were refraction errors (2927; 34.5%), squinting (239; 2.8%), and swelling (108; 1.3%). There were 128 (1.5%) subjects who received multiple diagnoses.

Gender was shown to have a statistically significant association ($p<0.05$) with the development of multiple diagnoses, including: strabismus, redness, itching, microcornea, watering eyes, and an injury obtained to the eye. Among males, there was an increased association of redness ($p<0.001$), itchiness ($p=0.014$), watering ($p=0.031$), and eye injury ($p=0.014$). Females had a higher likelihood of developing strabismus ($p=0.001$) and microcornea ($p=0.042$). The full list of gender associations is presented in Table 1.

There was a relationship between the age of students and the diagnosis of strabismus, blepharitis, coloboma, corneal opacity, ptosis, swelling, microcornea, refraction errors,

watering, and cataract development. The average age of diagnosis was younger for students with strabismus ($p<0.001$), blepharitis ($p=0.010$), coloboma ($p<0.001$), corneal opacity ($p=0.038$), ptosis ($p=0.001$), swelling ($p=0.026$), microcornea ($p=0.030$), watering ($p=0.016$), and cataract development ($p=0.003$). The only diagnosis that was more likely among older students was refraction errors ($p<0.001$). Associations between diagnoses and age are summarized in Table 2.

Unsurprisingly, student grade was associated with most of the same diseases that were found to be associated with age, as both age and grade are highly correlated in this dataset. None of the examined subjects showed signs of Vitamin A deficiency.

Discussion

In rural India, preventable blindness is prevalent at epidemic levels (Singh et al., 2000). The most comprehensive study to date of the Indian population, conducted in 2001, sampled fewer than 12,000 subjects and did not examine children under 15 (Dandona & Dandona, 2001). Nevertheless, they found that the most common causes of impaired vision were retinal diseases (35.2%), amblyopia (25.7%), optic atrophy (14.3%), glaucoma (11.4%), and corneal diseases (8.6%). Not surprisingly, prevalence of reduced vision increased with advancing age and with decreased socioeconomic status (Dandona & Dandona, 2001).

In addition, Dandona and Dandona (2001) found that while cataracts were the leading cause of blindness in the general population, the odds of this statistical association was 96% higher for women than men and (the same association was 72% higher in rural areas). For all causes, women were 37% more likely than men to be blind. It should be noted that the data set used by Dandona and Dandona was largely comprised of adults. In our sample, while gender differences were present, there was nothing resembling this profoundly disproportionate representation described in the 2001 study. While cataract development was relatively rare amongst children in our study, there was no significant difference in prevalence between males and females.

Furthermore, refraction errors (astigmatism) were the most common diagnoses, followed by various degrees of squinting and then swelling. This result aligns with other global studies of pediatric ophthalmology, including a

Table 1 Association between Gender and Ophthalmological Diagnosis.

Disease	*P-value (chi-square)*
Strabismus	0.001
Bitot's Spots	0.275
Redness	<0.001
Blepharitis	0.355
Coloboma	0.113
Corneal opacity	0.975
Ptosis (drooping)	0.744
Itching	0.014
Swelling	0.405
Microcornea	0.047
Refraction error	0.304
Squinting	0.994
Watering	0.031
Injury	0.014
Nystagmus	0.318
Cataract	0.964

Table 2 Association between Age and Ophthalmological Diagnosis.

Disease	*P-value (chi-square)*
Strabismus	<0.001
Bitot's Spots	0.238
Redness	00972
Blepharitis	0.010
Coloboma	<0.001
Corneal opacity	0.038
Ptosis (drooping)	0.001
Itching	0.104
Swelling	0.026
Microcornea	0.030
Refraction error	<0.001
Squinting	0.601
Watering	0.016
Injury	0.526
Nystagmus	0.774
Cataract	0.003

Swedish study in which astigmatism and strabismus were the most commonly described results after screening (Kvarnström, Jakobsson, & Lennerstrand, 2001). Strabismus was also commonly found in a study pertaining to children adopted from Eastern Europe (Grönlund et al., 2010). For our sample, strabismus was generalized to incorporate various related diagnoses, including alternating exotropia, alternating esotropia, hypotropia, hypertropia, and amblyopia.

Studies examining eye disease among rural Indian school-age children are rare, despite some consensus that global rates of ophthalmological issues among children are rising (Gwiazda, Grice, Held, McLellan, & Thorn, 2000). Diagnosis is a necessary step before treatment. Thus, an inability to detect eye disease at an early age (many of which are likely preventable or curable) hobbles treatment efforts. In reference to the current study, the diagnosis of astigmatism can be corrected with appropriate corrective lenses if the resources are available to the population and a diagnosis can be made. In total, 43.8% of the Srikiran pediatric population was diagnosed with eye disease, which is a concerning number. Beyond age and gender, our study offers no insight into additional factors that may predict the development of eye disease, such as caste, socioeconomic status, nutritional profile, sun exposure, or specific activities pursued. We have demonstrated a high burden of disease among this youth population, which must be the foundation of future investigation into predictive factors and the effectiveness of treatment regimens.

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Reducing the Global Burden of Depression

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Résumé :

(traduction)

On s'attend à ce que la dépression deviennent l'une des principales causes de morbidité d'ici 2020. Toutefois, les méthodes actuelles de traitement pour la dépression risquent de ne pas être efficaces dans la réduction du fardeau mondial que pourrait devenir cette maladie. Actuellement, la pharmacothérapie représente la première ligne de traitement pour les troubles dépressifs, néanmoins de nombreux effets indésirables liés aux antidépresseurs sont souvent négligés et leur interférence avec la chimie du corps peut ne pas être idéal pour un traitement à long terme.

Afin de réduire le fardeau de cette maladie, d'autres méthodes de traitement tels que le coaching et les thérapies doivent être considérées comme des solutions de rechange à la pharmacothérapie. Plus important encore, ces traitements réduisent l'apparition d'une rechute vers la dépression, ce qui les rend plus efficaces à long terme. En plus des méthodes alternatives de traitement, les stratégies de prévention de la dépression devrait être une priorité. Non seulement la prévention de la dépression est la meilleure solution thérapeutique, mais elle est aussi la plus rentable pour réduire la morbidité mondiale. La mise en œuvre de telles stratégies requiert cependant plus de données factuelles sur la prévention des troubles dépressifs.

Mots-clés : Traitement de la dépression, antidépresseurs, Thérapie cognitive comportementale, counseling, prévention de la dépression

Abstract:

Depression is expected to be one of the leading causes of morbidity by 2020. Nonetheless, the current methods of treatment for depression may not be effective in reducing the global burden of this disease. Currently, pharmacotherapy represents the first line treatment for depressive disorders; however, many adverse effects of anti-depressants are often overlooked and their interference with body chemistry may not be ideal for long-term treatment.

In order to reduce the burden of disease of depression, methods of treatment such as counseling and therapy should be considered as alternatives to pharmacotherapy. Most importantly, these treatments reduce the occurrence of depression relapse, making them more effective in the long-term. In addition to alternative methods of treatment, depression prevention strategies should be prioritized. Not only is depression prevention the best solution therapeutically, but it is also the most cost-effective in reducing global morbidity. In order to implement these strategies, however, more evidence-based research on the prevention of depressive disorders is required.

Keywords: Depression treatment, antidepressants, cognitive behavioral therapy, counseling, depression prevention

By the year 2020, depression is estimated to be the second leading cause of disability adjusted life years (DALYs) calculated for all ages (Reddy, 2010). The term DALY refers to one year of life lost due to death or disability (World Health Organization, 2014) and is used as a measure of morbidity within a population. Current attitudes towards treatment of depression will not reduce its present and projected disease burden. Conversely, improving measures to treat and prevent chronic depression may help to reduce the incidence of DALYs. First, the disadvantages of the current method of treatment should be recognized. Second, alternative and effective methods of treatment should be provided. Finally, it is important that gaps in knowledge of depression prevention be filled in order to reduce the rising number of DALYs.

The current method of treating depression is through pharmacotherapy; however, the adverse effects of medication are often disregarded. Antidepressants often create a sense of dependency, meaning the illness is kept in remission rather than being truly cured. Andrews and colleagues (2012) support this notion by describing how antidepressants increase the brain's susceptibility to future depressive episodes after they have been discontinued. In addition, certain anti-depressants may interfere with body chemistry and produce adverse effects in patients. For example, gastrointestinal problems, central nervous system problems, hypernatremia and bleeding are known side effects of specifically selective serotonin reuptake inhibitors (SSRIs), the first-line treatment for depression (Khawam, Laurencic, & Malone, 2006). Khawam and colleagues (2006) also identified side-effects as the most common reason for premature anti-depressant discontinuation, which is evident in 44% of patients after three months of treatment. As such, from the patient's perspective the harm caused by anti-depressants is not worth the treatment benefits they provide.

The role of pharmaceutical company's agendas in the debate against antidepressants is also an important factor in causing public skepticism about drug effectiveness. In a systemic literature review, Turner and colleagues (2008) found that drug companies selectively publish studies on antidepressants and omit those reporting the drugs as ineffective. This suggests that the business and revenue goals of these pharmaceutical companies may trump their interest in providing an effective treatment. In addition, for many depression patients the emotion-numbing effect of antidepressants may actually enhance the self-destructive behaviours that the drugs are meant to prevent. For example, Padala and colleagues (2012) suggest that certain antidepressants, specifically SSRIs, contribute to feelings of lost motivation and apathy in patients with depression. Consequently, the use of pharmacotherapy may exacerbate depressive symptoms rather than treat them. For both of these reasons, alternative methods of treatment should be recognized.

Instead of only targeting the biomedicine of depression, alternative treatments include more holistic approaches such as counseling and therapy. These non-invasive methods take into account the patient's personal experiences and environment, which may have acted as triggers for the depression. There is substantial evidence suggesting that counseling and cognitive therapy are equally effective alternatives to antidepressants in treating depression. DeRubeis, Siegle, and Hollon (2008) performed a meta-analysis and found no differences in the outcomes of cognitive therapy versus pharmacotherapy in severely depressed patients. Chilvers (2001) also discovered similar results for generic counseling, stating that it is an equally effective treatment for mild to moderate depressive illness. Vittengl, Clark, Dunn, and Jarrett (2007) found that there were lower rates of depression recurrence after cognitive behavioural therapy in comparison to pharmacotherapy. In addition to an equivalent efficacy in treating immediate symptoms, counseling and therapy reduce the likelihood of relapse in depression patients, as they target the initial causes of depression. Therefore, unlike pharmacotherapy, counseling methods attempt to find a permanent and long-term solution for the treatment of depressive disorders.

In addition to improving the alleviation of depression and preventing its relapse among individual patients, the implementation of prevention strategies may reduce the burden of disease expected from depression on a population level. Cuijpers, Beekman, and Reynolds (2012) have demonstrated that preventative measures such as psychotherapeutic and lifestyle interventions reduce the incidence of depression by 25-30%. In financial analysis, Cuijpers and colleagues (2012) have also found that the cost of averting 1 DALY due to depression is below the current ceiling of $30,000 to $50,000, generally accepted by policy makers as cost-effective. Depression prevention may thus be the most effective strategy to decrease DALYs as it encompasses both economics and therapeutic benefits for patients; however, in order to effectively establish effective depression prevention strategies, more evidence-based research is required. Until such time, simple preventative measures for depression are available, such as controlling

stress levels, boosting self-esteem, and seeking friendship and social support (Mayo Clinic, 2014).

In order to effectively reduce the DALYs caused by depression, it is necessary that the disadvantages associated with antidepressants are acknowledged within the scientific community, cognitive behavioral therapy and counseling is more frequently selected as a treatment method, and evidence-based research on prevention is established. The use of antidepressants alone to treat depression will likely result in remission and eventual relapse of depressive episodes, while counseling, therapy and prevention will collectively benefit the population in the long term.

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Health Sciences (HSS) Buddy Program: Evaluation of its First Year

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Résumé :

(traduction)

Durant l'année scolaire 2011-2012, le projet pilote du programme de parrainage en sciences de la santé a été mis en œuvre au sein de l'École interdisciplinaire des sciences de la santé de l'Université d'Ottawa. Destiné à répondre à la hausse du niveau d'anxiété des étudiants, le programme a associé étudiants de première année et groupes d'étudiants plus âgés afin de promouvoir leurs occasions d'échange. La perception des participants de ce programme se traduit par des termes universellement positifs quant au plaisir qu'il procure, à son utilité et à sa pertinence pour les besoins des étudiants. Au nombre des améliorations proposées figurent le recrutement de plus de participants masculins, la liaison avec les administrateurs scolaires pour éviter les conflits d'horaire, faire débuter le programme plus tôt dans l'année scolaire, et la formation de groupes sociaux avec moins d'étudiants. Dans l'ensemble, l'approche adoptée par le programme de parrainage est fort bien acceptée et on souhaite la continuation de son développement.

Mots-clés :

Mentorat, étudiant universitaire, projet pilote, dépression, soutien par les pairs, stress scolaire, milieu académique, éducation

Abstract:

In the 2011-2012 academic year, the HSS Buddy Program pilot project was implemented in the Interdisciplinary School of Health Sciences at the University of Ottawa. Intended to address rising student anxiety levels, the program teamed freshmen (first year) students with groups of older students to promote more instances of casual social interaction. Participants' perceptions of the program were universally positive in terms of how enjoyable it was, its usefulness, and its relevance to student needs. Suggested improvements include recruiting of more male participants, liaising with school administrators to help avoid scheduling conflicts, starting the program earlier in the academic year, and forming social groups with fewer students. Overall, the approach undertaken by the Buddy Program was seen to be a valuable one worthy of continuation and growth.

Keywords:

Mentorship, university students, pilot study, depression, peer support, school stress, academia, education

Introduction

According to Statistics Canada's 2012 Mental Health Survey, Health At A Glance, young people aged 15 to 24 years are at the greatest risk for mental illness. Additionally, suicide is the second leading cause of death among this age group (Statistics Canada, 2012). These statistics coincide with the typical life events of this demographic; they are likely to be moving away from home for the first time, pursuing post-secondary education, being evaluated by stricter academic standards, and navigating new and demanding social circles. The result is a number of factors that contribute to this population's unique vulnerability to mental and social anxiety.

To help address concerns about such anxieties, many of which may lead to mental illness, the bilingual (English/French) Health Sciences (HSS) Buddy Program pilot project was launched by the Interdisciplinary School of Health Sciences at the University of Ottawa in the 2011-2012 academic year. This peer-based social support program, which has since continued to operate, was intended to leverage student social contact to help minimize anxieties experienced by incoming freshmen students. A comparable mentorship program with similar objectives has shown benefits for youth, especially in reducing risk-taking behaviour and increasing confidence in school performance (Grossman & Tierney, 1998).

The HSS Buddy Program connected groups of freshman students with 'Buddies', who were upper year students. The objective of the buddy was to encourage group social activities in a supervised setting and subsequently move to unsupervised settings. At the beginning of the program, the 'Buddies' partook in a training session that informed them of the program's objectives and their role and responsibilities regarding their designated group of students. The five final groups consisted of students from several years (one through four) and ranged from four to six members. As the purpose of the initiative was focused on the social aspect of university life, it was not intended to provide academic mentoring or tutoring. With this pilot study, we sought to evaluate the effectiveness of the program by soliciting the perceptions of its participants.

Methods

At the end of the 2011-2012 academic year, the program's participants were emailed a request to complete an online questionnaire, which was hosted on the website SurveyMonkey.com. The questionnaire was anonymous and consisted of 33 questions, both multiple choice and open-ended, requiring approximately 10 minutes to complete. Respondents were asked about their perceptions of the program's logistics, whether it was enjoyable, and its usefulness. The questionnaire's three open-ended questions are shown in Table 1, with question #9 only given to the upper year 'Buddies'.

Table 1 Open-ended questions asked of Buddy Program participants.

Question number	*Question*
9	Do you have any suggestions for improving the training component of the Buddy program? *(for Buddy mentors only)*
25	What was the biggest barrier preventing more frequent meetings?
31	We'd really appreciate any comments or criticisms you might have for us.

Quantitative data were analyzed descriptively using SurveyMonkey's internal statistical analysis tool, with frequencies of responses reported. The open-ended questions were interpreted contextually using summative analysis, which involved an assessment of how frequently recurring responses occurred.

The project was funded by a student experience grant from the University's Faculty of Health Sciences. Approval for this study was granted by the Research Ethics Boards of the University of Ottawa.

Results

The program's inaugural year attracted 20 first-year students (5 males and 15 females) and 52 upper year Buddies (9 males and 43 females). The survey response rate was poor considering the small sample frame, with 24 Buddies (46%) and 8 first year students (40%) responding. Among all respondents, 89% were female and 89% were Anglophone.

More than half of the Buddies (52%) were 2nd year students, while 45% had been involved in some sort of prior peer support or mentorship program.

A large number of freshmen (43%) learned about the program through the leaders of their on-campus residences, while email and in-class announcements each accounted for 30% of respondents' awareness. Although half joined along with a friend, only 38% described themselves as shy or introverted.

The majority of Buddies (85%) felt their involvement in the program was beneficial both to them personally and to the first year students in their assigned social group. Also noteworthy is that 100% of the Buddies would have preferred that the program had been available when they had been freshmen. The majority of first year students (75%) found the program experience to be beneficial, while all respondents would recommend it to others.

All Buddy mentors found the training sessions to be appropriate, with 90% feeling that one day was sufficient for training. The least useful aspect of the training was the quality of the on-campus resources for mental illness identification and response, which were perceived to be poor. Despite this finding, 95% felt well prepared to take part in the program after the training session.

Interestingly, all but one of the freshmen reported that "making new friends" was the motivator for joining the program, with most (86%) desiring to make friends more among the upper year students than among their own cohort.

Most respondents (54%) reported that their social group met only once during the duration of the program, outside of the initial supervised gathering. A maximum of three meetings were had for the most active groups.

Table 2 The frequency of recurring responses that occurred categorized by themes.

Question number	*Scheduling*	*Group Size*	*Timing during the school year*	*Miscellaneous*
9	3		1	2
25	12	1	9	2
31	1	1	14	5
TOTAL	16	2	24	9

The results of the summative theme analysis of the open-ended questions are presented in Table 2, with Scheduling, Group Size, and Timing During the School Year being the topics most commonly touched upon.

From the open-ended responses, all respondents felt that the program had started too late, as it commenced approximately halfway through the academic year. Scheduling conflicts were also identified as a barrier to participation, as were the sizes of the social groups that were assigned. The latter observation is weakened by the finding that 61% of respondents felt that their group size was "just right," while only 32% felt it was "too big".

Discussion

All participants, both freshmen students and the Buddies, praised the HSS Buddy Program as being a rewarding experience. The program's intent was to help build social connections, which is known to promote a sense of belonging (Patton et al., 2006), which in turn may contribute to diminished stress and anxiety. It should be noted that while the program intentionally distanced itself from academic mentoring responsibilities, some groups were indeed observed to be engaging limitedly in activities relating to scholastic counseling. As academic mentoring services already exist on campus, the Buddy Program's participants did not report any dissatisfaction with the project's deliberate efforts to avoid pedagogical activities. Instead, the most common criticisms pertained to scheduling issues and group sizes, both of which might have resulted in a decreased frequency in group activity.

The short program duration and lateness of the program's launch were viewed negatively as well, and may have resulted in reducing the quality of the relationships formed. In similar youth mentoring programs, it has been shown that greater benefits are gained from programs that last a year or longer (Grossman & Rhodes, 2002). This weakness was unavoidable in the program's inaugural year given the one-time administrative issues that delayed the launch of the program until well into the second semester.

Program participation was higher among females, perhaps reflecting the known gendered nature of help-seeking behaviours (Good, Dell, & Mintz, 1989). College males, on the other hand, may restrict emotionality, perhaps resulting in a decrease in psychological well-being, increased anxiety, and negative help-seeking attitudes (Blazina & Watkins,

1996). Given this risk, it is advisable that the program's organizers consider avenues for reducing this skewed gender representation and encouraging males to participate.

The positive impressions of the program are not surprising, as the literature indicates a clear benefit from support programs targeted to youth issues (DuBois & Neville, 1997). In addition, the more frequent the mentor and participant interaction, the greater the perceived benefit of the relationship (DuBois et al., 2002); similarly, the longer the duration of the relationship, the greater the perceived benefit (Grossman & Rhodes, 2002). Conversely, poorly designed and implemented programs may have a negative effect on participant well-being and anxiety levels (DuBois et al., 2002). Hence, improvements in the organization and conduct of the program are not only important to improve its impact, but also to avoid negative impact.

Based upon our findings, we recommend the following improvements to the Buddy program: liaison with school administrators to better avoid scheduling conflicts with classes and exams, renewed focus on recruiting participants through improved program promotion, particularly male freshmen, an earlier start of the program in the academic year, and a reduction in the size of the social groups. With each incremental improvement, social networking initiatives such as this may help to assuage the broad trend of social anxiety among young adults.

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École Interdisciplinaire des sciences de la santé — Université d'Ottawa, Canada

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Interdisciplinary School of Health Sciences — University of Ottawa, Canada

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Lauréats de la section française

CONCOURS DE PRÉSENTATION PAR AFFICHE EN ÉPIDÉMIOLOGIE 2014

Sujet : Alzheimer

Préparé par : A. Chaumont, A. Laurin, M. Lepage-Ratté

Sujet : Hypothyroïdie congénitale

Préparé par : C. Houlton, S. Lamont-Paradis

Sujet : Hypertension

Préparé par : M. Cousineau, C. Dicaire, S. Fakhry, C. Larche-Boudreau

Sujet : Syndrome post-commotionnel

Préparé par : P. Guidone, D. Cazeau

English section laureates

2014 Epidemiology Poster Competition

First place

Title: Alternative Therapy for ADHD
Authors: C. Katan, L. M. Buder, R. Saikaly

Title: Invega - Quality of life of Schizophrenia
Authors: P. D. Dumochel, V. Fomitcheva

Second place

Title: Obstructive Sleep Apnea and its effects on Atrial Fibrillation
Authors: A. Fang, B. Frisch

Third place

Title: Is ADHD over diagnosed in children?
Authors: N. Sangwa, A. Demanti, M. Ahmad

Title: Incidence of respiratory illness among children under the age of 18 living in urban areas
Authors: C. Nathoo, J. Hems, R. Dimanlig, S. Sinnadurai

APPEL À CONTRIBUTIONS

Les critères de soumission se basent sur les douze déterminants de la santé, tels que définis par Santé Canada et l'Agence de santé publique du Canada. Idéalement, toute personne qui souhaite soumettre un manuscrit à la RISS devrait clairement identifier quel déterminant de la santé est associé à sa recherche, ainsi que la nature de cette relation : *de quelle façon le sujet à l'étude est-il relié à la santé humaine, à travers le déterminant de la santé choisi ?*

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