



Catalogue no. 62F0026MIE — No. 001
ISSN: 1708-8879
ISBN: 0-662-40414-9

Research Paper

Household expenditures research paper series

Using Median Expenditures : Impact on Household Spending Data

2003

by May Holmes and Karen Maser

Income Statistics Division
Jean Talon Building, Ottawa, K1A 0T6
Telephone: 613 951-7355



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May 2005

Catalogue no. 62F0026MIE2005001

ISSN 1708-8879

ISBN 0-662-40414-9

Frequency: Occasionnal

Ottawa

La version française de cette publication est disponible sur demande (n° 62F0026MIF au catalogue).

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Executive summary

Statistics Canada has produced statistics on household spending for about five decades. A number of key statistics have been published over this period, one of the most important ones being the average (arithmetic mean) expenditure.

In recent years the median has been used more often by Statistics Canada's household income and wealth surveys, in addition to the average. Beginning with the reference year 2003, median expenditures will also be published by the Survey of Household Spending (SHS).

This paper provides some guidance to users on the use of this statistic and also gives some examples of situations when it can be a more appropriate measure than the average.

1. Introduction

Statistics Canada has published estimates of household spending for several decades. The source for this information is the Survey of Household Spending (SHS), a complex household survey which has been conducted annually since 1997. Prior to that year, this survey was done on an irregular basis, and was known as the Survey of Family Expenditures (FAMEX).

The data for the SHS are collected by personal interview; the useable sample is about 17,000 private households across Canada. Although the focus is on household expenditures, topics covered also include: household composition, dwelling characteristics, household equipment, personal income, asset change, unincorporated businesses and liabilities. On average, each interview takes about two hours.

Over the years, the statistical products from the SHS (and FAMEX) have changed, but the key statistics—average annual expenditure per household, budget share and percentage reporting—have largely remained the same. (See Appendix A for details.) These statistics are similar to the ones produced by other countries conducting household spending surveys (see Appendix B). Although the average is a very useful and important measure, the decision was made, beginning with the data for the year 2003, to include another measure of central tendency as well, the median.

Estimates of median expenditures per household and median expenditures per household reporting for 1997 to 2003 were released on December 13, 2004. The *Daily* announced that the medians were included in the five standard release tables (by geographical area, income quintile, tenure, household type, and size of area). The *User Guide* referred to the medians in its descriptions of each of the standard release tables and it advised readers that the CVs for the medians were available on request. The 2003 SHS publication will include medians per household reporting in its Canada level table of detailed expenditures. Median estimates will also be available on CANSIM in the future.

This move will bring the SHS in line with other household surveys in Statistics Canada producing information on income and wealth, which now provide estimates based on this measure.

This paper discusses the differences between the average and the median, using data from the SHS, in order to assist users in determining the more appropriate measure for their purposes.

2. Average and median: advantages of each

The average, or arithmetic mean, is calculated by dividing the total amount (e.g., total expenditures) by the number of units, in this case the number of households. The median, on the other hand, is obtained by sorting the values (e.g., amount spent) for each unit in ascending or descending order and selecting

the value in the middle. Therefore, half of the units would have lower values, and half, higher.

One of the important advantages of the average is that it can be easily calculated, and is easily understood. Users who have information on total amounts spent, and on the number of units in the population, can calculate the average. This is not true of the median; it can be generated only with microdata, not with aggregate data. Therefore, it must always be supplied.

However, the median, from the point of view of a measure of central tendency, has an advantage over the average because it is not influenced by outliers. Outliers—unusually high or low values—can either lower or raise the average. The median, in fact, presents a better “picture” of the situation of the unit in the middle. As well, it tends to be more stable over time, again because it is not subject to the impact of outliers.

Care must be taken when using either the average or the median as they can both be determined in two ways, by taking into consideration either all units, or only those units that have a particular expenditure. For example, the average and median expenditure on child care is much lower for all units (i.e., households) than for only those making that expenditure because not all households have children, or the need for child care. The most appropriate figure to use will depend on the type of analysis being done.

Because of the nature of the median, in those situations where less than 50% of the units (households) have a particular expense, the value of the median will be zero.

As mentioned previously, budget share (the distribution of expenditures between the various expenditure items) has also been one of the key statistics generated by the SHS. The budget share is calculated by the SHS using the average for all units, as these shares are additive, that is, they add to 100%. Budget share cannot be calculated using medians as these percentages do not add to 100%. (See Table 1.)

Table 1
Summary level expenditures as a percentage of total expenditures,
Canada¹, 2003

	<i>Average</i> expenditure per household ² (\$)	Percentage of total <i>average</i> expenditure (%)	<i>Median</i> expenditure per household ² (\$)	Percentage of total <i>median</i> expenditure (%)
Total expenditure	61,127	100.0	51,493	100.0
Food	6,785	11.1	6,118	11.9
Shelter	11,582	18.9	9,240	17.9
Household operation	2,869	4.7	2,230	4.3
Household furnishings and equipment	1,750	2.9	895	1.7
Clothing	2,435	4.0	1,700	3.3
Transportation	8,353	13.7	4,919	9.6
Health care	1,589	2.6	1,092	2.1
Personal care	834	1.4	623	1.2
Recreation	3,585	5.9	2,138	4.2
Reading materials and other printed matter	283	0.5	181	0.4
Education	1,008	1.6	0	0.0
Tobacco products and alcoholic beverages	1,486	2.4	680	1.3
Games of chance (net)	271	0.4	60	0.1
Miscellaneous expenditures	904	1.5	350	0.7
Personal taxes	12,367	20.2	7,290	14.2
Personal insurance payments and pension contributions	3,503	5.7	2,624	5.1
Gifts of money and contributions	1,522	2.5	200	0.4
Sum of parts	61,126	100.0	40,340	78.3

1. 10 provinces only

2. based on all households

There are, therefore, several reasons why the median should not replace the average. It can, however, provide useful supplementary information and, when compared with the average, it can provide insight into the impact that outliers have on the estimates.

3. Average and median expenditures from the SHS, Canada, 1997-2003

3.1 Total expenditures

Table 2 illustrates how the expenditure picture differs using the average and median as measures of central tendency. For 2003, the average total expenditure per household was \$61,127; median total expenditures were 16% lower than that, \$51,493 (see Table 2). This shows the extent to which the average was affected by those households with much higher expenditures. Median expenditures therefore provide a better reflection of the spending of the household in the middle.

Table 2:
Average and median expenditures, Canada¹, 2003

	% reporting	Average expenditure (\$)		Median expenditure (\$)		% difference ²	
		per household	per household reporting	per household	per household reporting	per household	per household reporting
Total expenditure	100	61,127	61,127	51,493	51,493	-16	-16
Total current consumption	100	43,735	43,735	37,929	37,929	-13	-13
Food	100	6,785	6,785	6,118	6,120	-10	-10
Shelter	100	11,582	11,594	9,240	9,249	-20	-20
Principal accommodation	100	10,907	10,931	8,700	8,717	-20	-20
Rented living quarters	35	2,448	7,067	0	6,518	-100	-8
Owned living quarters	68	6,467	9,477	3,304	7,500	-49	-21
Water, fuel and electricity	88	1,992	2,267	1,992	2,177	0	-4
Other accommodation	44	676	1,532	0	625	-100	-59
Household operation	100	2,869	2,870	2,230	2,231	-22	-22
Communications	99	1,255	1,265	1,067	1,075	-15	-15
Child care expenses	11	294	2,568	0	1,500	-100	-42
Pet expenses	52	337	651	20	420	-94	-35
Other household operation	100	983	987	685	690	-30	-30
Household furnishings and equipment	94	1,750	1,862	895	1,004	-49	-46
Clothing	99	2,435	2,456	1,700	1,710	-30	-30
Transportation	98	8,353	8,510	4,919	5,049	-41	-41
Private transportation	88	7,640	8,730	4,272	5,069	-44	-42
Public transportation	68	713	1,057	133	505	-81	-52
Health care	97	1,589	1,635	1,092	1,132	-31	-31
Personal care	99	834	840	623	630	-25	-25
Recreation	98	3,585	3,659	2,138	2,206	-40	-40
Reading materials and other printed matter	84	283	337	181	232	-36	-31
Education	45	1,008	2,267	0	665	-100	-71
Tobacco products and alcoholic beverages	85	1,486	1,755	680	1,000	-54	-43
Tobacco products and smokers' supplies	37	730	1,952	0	1,500	-100	-23
Alcoholic beverages	79	756	961	300	500	-60	-48
Games of chance (net)	74	271	367	60	125	-78	-66
Miscellaneous expenditures	90	904	1,001	350	430	-61	-57
Personal taxes	92	12,367	13,464	7,290	8,500	-41	-37
Personal insurance payments and pension	81	3,503	4,317	2,624	3,469	-25	-20
Gifts of money and contributions	73	1,522	2,080	200	484	-87	-77

1. ten provinces only

2. (median-average)/average*100

The trend line showing total expenditures from 1997 to 2003 was consistently higher for the average than for the median, but the movement of these lines was similar for both measures. (See Chart 1)

Chart 1
Total expenditures per household, Canada, 1997-2003

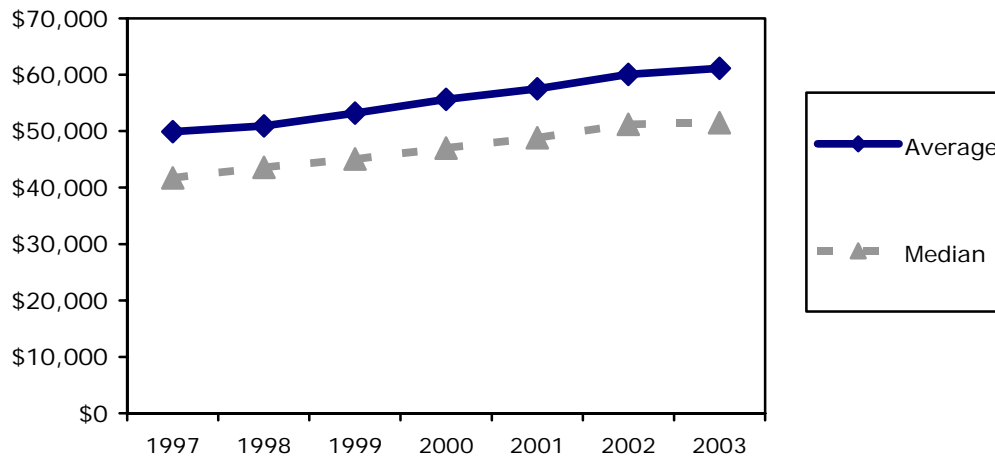


Table 2 also illustrates how the average and median expenditures differ if they are based on all households, or only those reporting a particular expenditure. The difference between the two can be substantial if only a relatively few households report a given expense.

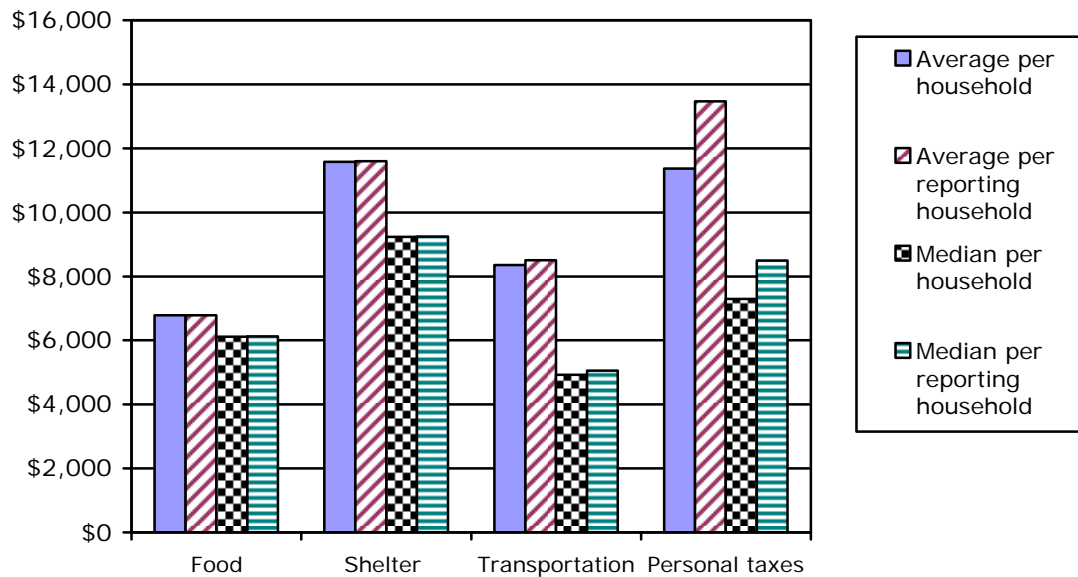
These measures will be compared for the more common expenditure items, and some less common ones.

3.2 Common expenditure items

To see how average and median expenditures compare, we will look first at the four largest, most commonly reported expenditure categories (see Table 2): food (100%), shelter (100%), transportation (98%) and personal taxes (92%).

In all cases the average expenditure was higher than the median, because of the impact of those who spend much larger amounts on a given category. (See Chart 2.) The difference between these two measures was, not surprisingly, much smaller for food, given that the range in spending on food items is not as large as it is for some other types of expenditures. Outliers are therefore less likely to have the same impact for this category. The median expenditure on food was just 10% lower than the average, one of the smallest differences in Table 2. The difference, although larger, was still relatively small for shelter (20%), again because outliers do not have as pronounced an effect on this spending category as some others.

Chart 2
Average and median expenditures for selected common expenditure categories, 2003



For both transportation and personal taxes, however, the median expenditure was about 40% lower than the average, an indication that some households spend much larger amounts on these categories. Given that expenditures for transportation, for example, can range from the cost of public transportation to the purchase of a vehicle, this can be easily explained. The average expenditure on transportation (\$8,353) was close to \$3,500 higher than the median; this is because over 10% of households spent at least \$20,000 on transportation in 2003.

Those with very high income would be required to pay more for personal taxes, again inflating the average for that category. Close to 20% of households paid at least \$20,000 in personal taxes in 2003, resulting in an average expenditure estimate which was almost \$5,000 higher than the median.

Because almost all households reported expenditures in each of these categories both measures (average and median) are very close whether based on all households or only those households reporting that category. The difference was somewhat greater for personal taxes, as a slightly higher percentage of households (8%) did not report paying any personal taxes in 2003.

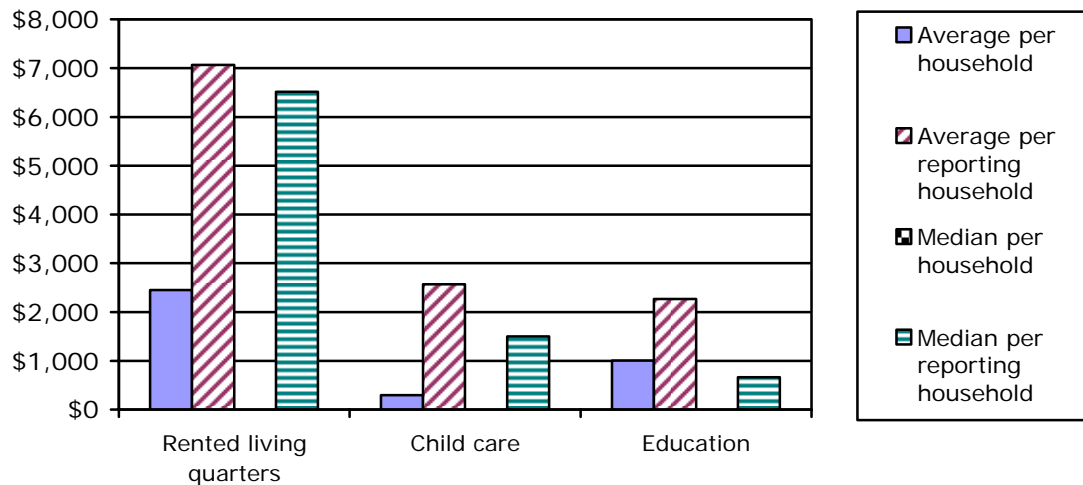
3.3 Less common expenditure items

A rather different perspective on the relationship between the two measures of central tendency emerges by looking at some of the less common expenditure items, that is, expenses reported by a much smaller percentage of households. From Table 2, the following items have been selected: expenses associated with

rented living quarters (reported by 35% of households), child care expenses (reported by 11%), and education expenses (by 45%).

Because all of these items were reported by less than 50% of households, the median expenditure per household was \$0. (See Chart 3.) In these situations, the median is a more meaningful measure if based only on those households reporting expenditures for a particular item. For the average, also, the amount based on all households is significantly lower than for only those households reporting that item. The more appropriate figure to use would depend on the nature of the analysis being done. For example, if a study was conducted on the cost of renting by metropolitan area, the researcher would be interested in averages, or medians, for only those households reporting such expenditures. On the other hand, if looking at an expense for a particular population, say child care costs for families with young children, one might want to calculate the average, or median, for all households in that population, not just the households reporting that expense.

Chart 3
Average and median expenditures for selected less common expenditures, 2003



The difference between the average and median expenditure per reporting household is, as we saw with the more common expenditures, greater for those expenditure items on which some households are likely to spend much larger amounts. The average is increased by these large amounts; the median is not affected in the same way. For those items in Chart 3 the largest difference between the average and median amount per reporting household is for education; the median is 71% lower than the average. These expenses range from supplies to tuition fees for all levels of education. Tuition fees impact the most on the average.

Expenses associated with child care costs were also much lower when expressed using the median; that measure was \$1,500 per reporting family, 42% lower than the average expenditure for this category.

4. Expenditures for selected groups

The contrast between median and average expenditures can also provide useful information when examining the situation of different populations or groups. In this section this is done by looking at the average and median expenditures per household for different provinces, household types, income quintiles and tenure types. (See Table 3.)

Average expenditures for each of the provinces ranged from \$48,919 for Newfoundland and Labrador to \$68,118 for Ontario. In all cases, the median was lower by 12% to 18%. Using the median changed the ranking of the provinces in terms of spending: Alberta, not Ontario, had the highest expenditures, because outliers had a somewhat larger impact on average spending in the latter province. Newfoundland had the largest difference between the average and median (the latter was 18% lower); this can be partly attributed to the large percentage of households with lower expenditures. Over 12% of households spent less than \$15,000 in 2003, compared with 7% for all provinces.

There was a substantial difference between median and average expenditures by household type. For example, the median was 22% lower than the average for one-person households but only 10% lower for couple households with children. If looking at the spending patterns of one-person households, the average (\$31,959) presents a somewhat inflated picture of the expenditures of this group. In fact, 25% of one-person households spent less than \$15,000; the median spending for that group (\$25,070) better reflects that.

Differences between the average and median tend to be somewhat smaller by income quintile, particularly for the three middle quintiles. (Quintiles are determined by sorting households from highest to lowest income and dividing them into five groups of equal size.) This is not surprising; one might expect outliers to have a smaller impact when households within a similar income range are grouped together. For the highest and lowest income quintiles the differences were larger: the median was 11% lower than the average for the highest income quintile and 13% lower for the lowest quintile. Although outliers explain this in both cases, the amount of spending required to influence the average is obviously much smaller for the lowest quintile than the highest.

Table 3
Total expenditures by category, Canada¹, 2003

	Total expenditures per household		
	Average (\$)	Median (\$)	% difference ²
Canada	61,127	51,493	-16
Province			
Newfoundland and Labrador	48,919	40,213	-18
Prince Edward Island	49,451	42,293	-14
Nova Scotia	54,295	45,982	-15
New Brunswick	49,109	42,979	-12
Quebec	54,198	44,822	-17
Ontario	68,118	57,967	-15
Manitoba	55,111	46,321	-16
Saskatchewan	53,435	45,755	-14
Alberta	66,489	58,164	-13
British Columbia	60,089	52,268	-13
Household type			
One-person	31,959	25,070	-22
One-person 65+	23,743	17,912	-25
All couples	75,673	66,634	-12
Couple both 65+	43,712	32,698	-25
Couple only	61,442	52,018	-15
Couple with children	84,224	76,138	-10
Couple with additional persons	89,708	75,708	-16
Lone parent	44,818	40,953	-9
Lone parent female-headed	41,600	37,910	-9
All other households	58,740	50,653	-14
Other households all related	57,157	50,040	-12
Other households at least one person unrelated	61,252	51,517	-16
Income quintile			
Lowest	20,228	17,554	-13
Second	35,737	33,001	-8
Third	52,584	50,308	-4
Fourth	73,717	71,188	-3
Highest	123,370	109,540	-11
Tenure			
Owner without a mortgage	60,903	48,101	-21
Owner with a mortgage	83,260	74,568	-10
Renter	37,007	31,735	-14

1. 10 provinces only

2. (median-average)/average*100

Interesting differences can also be seen by tenure, the housing status of the household. For homeowners without mortgages the median was significantly lower than the average (21%), compared with 10% for homeowners with mortgages. Although homeowners with mortgages spent substantially more than those without—because of the mortgage payments—there were more outliers in the latter group. This may be because having more disposable income puts some in a position to make relatively large expenditures. For renters, the median was 14% less than the average. Although this difference was more comparable to that of the homeowners with a mortgage, the average and median spending of renters was much lower.

5. Two examples

To further illustrate how the expenditure picture differs using the median as opposed to the average, we will now look at spending on two different expenditure items, using SHS data for the years 1997 to 2003. In these cases, the average and median are not based on all households, but only on those reporting the expenditure. This has been done because these expenditures are not very common.

Additions, renovations and alterations for the home

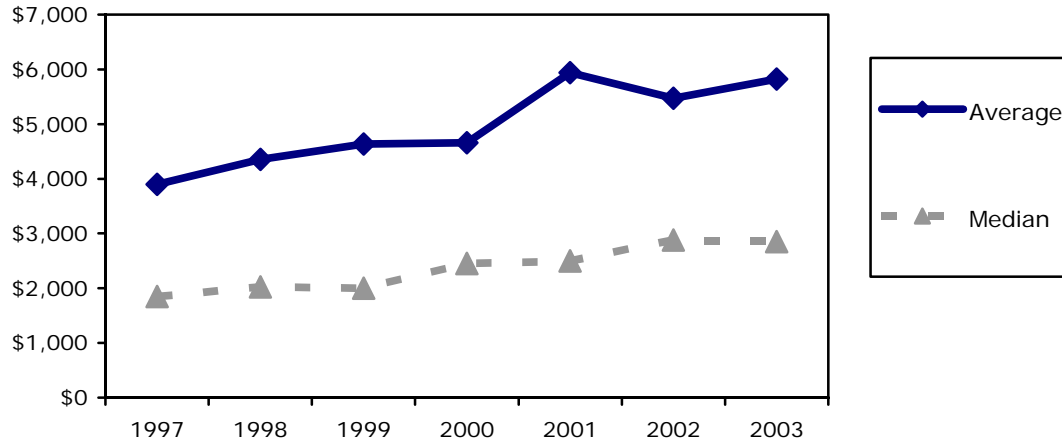
Expenditures on additions, renovations and alterations for the home were chosen as the first example because these expenditures are more volatile than most other expenditure items. It should be noted that these expenditures are classified separately from the ones listed in Table 2 because they are considered as changes in the value of household assets.

Expenditures for additions, renovations and alterations for the home were reported by approximately one-quarter of Canadian households. Projects ranged in complexity and cost—from replacing a window to putting a second storey on a house. A small number of households had very high expenditures (outliers), which affected the averages. Over this period the median was consistently much lower than the average, ranging from 47% in 2000 and 2002, to 58% in 2001.

Changes in the average and median expenditures on additions, renovations and alterations over the period 1997 to 2003 are illustrated in Chart 4. The average trend line shows steep changes from 2000 to 2001, because of the impact of the outliers. On the other hand, the median trend line is much smoother, making it possible to provide a more realistic impression of annual changes.

In this type of analysis, it might be useful to use both the median and the average, because of the benefit of being able to relate one measure to the other.

Chart 4
Additions, renovations and alterations expenditures per household reporting, Canada, 1997-2003



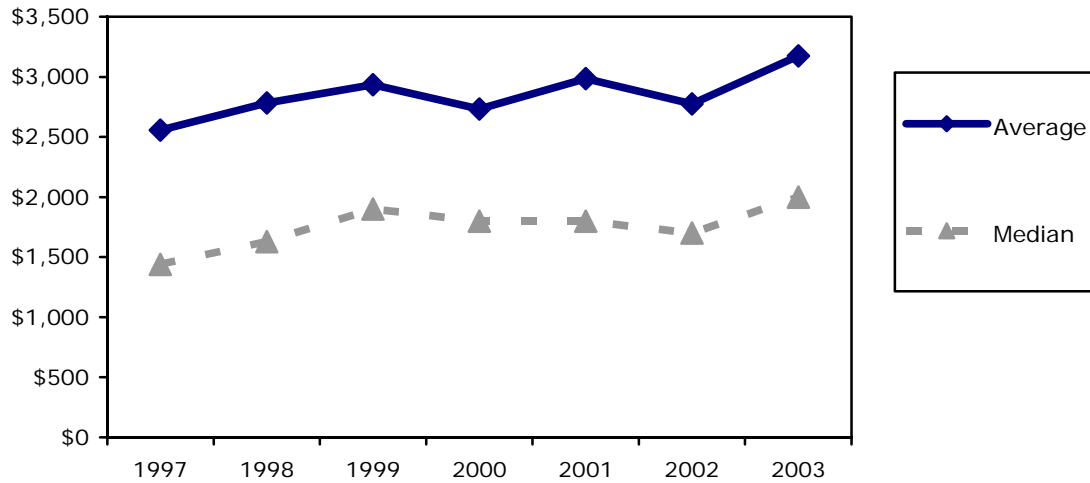
Child care

Child care expenses have been the subject of much debate both in the legislatures and the media. The SHS information can shed light on this debate as it collects information on expenses associated with care of children both within and outside the home.

In this example we focus on the population most likely to incur child care expenditures: households with children aged 4 or under. Child care expenditures were reported by 56% of these households in 2003.

Changes in the average and median expenditures on child care over the period 1997 to 2003 are shown in Chart 5. The average and median trend lines both show fluctuations from year to year, although the annual changes for the two measures are often quite different.

Chart 5
Child care expenditures per household reporting, households with children aged 4 or under, Canada, 1997-2003



Focusing on 2003 for households reporting these expenditures, the median expenditure on total child care, at the Canada level, was 37% less than the average expenditure. (See Table 4.) By looking at the types of expenses within this category, it is possible to shed some light on the reasons for this gap. The difference between the median and average is relatively small (the median is 30% lower) for costs associated with day care centres. (This includes out-of-pocket expenses only.) Day care centres provide a relatively standard service and the associated costs tend to be more comparable. The difference in the two measures of central tendency is much greater for child care in the home. These expenses can range from relatively inexperienced babysitters for a few hours a year to full-time nannies. In this case the median was 83% lower than the average. For a thorough analysis of child care expenses, it would then be important to consider not only the types of care to be included, but also whether the average or the median better reflects the “typical” household.

Table 4
Child care expenditures for households with children aged 4 and under,
Canada¹, 2003

	% of group reporting	Average expenditure (\$)		Median expenditure (\$)		% difference ²	
		per household	per household reporting	per household	per household reporting	per household	per household reporting
Total child care	56	1,761	3,175	200	2,000	-89	-37
Child care outside the home	45	1,329	2,961	0	2,020	-100	-32
Day-care centres	34	978	2,861	0	2,000	-100	-30
Other child care outside the home	15	350	2,299	0	1,300	-100	-43
Child care in the home	24	432	1,771	0	300	-100	-83

1. 10 provinces only

2. (median-average)/average*100

This second example shows that it can be helpful to have a variety of statistics to use for data analysis. Averages and medians can both provide valuable insights about household spending.

6. Summary

This paper has looked at the impact of introducing another measure of central tendency—the median—to the output from the Survey of Household Spending. This measure can be useful on its own and also useful when compared with the measure traditionally used by this survey, average expenditures.

The major advantage of the median is that it is not affected by outliers in the same way that the average is. This characteristic makes it useful for a survey such as the SHS, given that households with much higher expenditures have an influence on the average and therefore affect the picture of household spending that is presented using that statistic. As was shown, looking at total expenditures for 2003, the median amount spent by households was considerably (16%) lower than the average. For expenditure categories on which some households can spend much more than others, the difference can be much greater. For example, median expenditures on transportation in 2003 were 41% lower than average expenditures.

The average will continue to have an important place in the output produced by SHS. It is the basis for calculating budget share, another important statistic, and is also easily understood and calculated. Adding the median to the available output will provide users with additional information on spending patterns and will also give them the option of using another measure of central tendency when this might be more appropriate.

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Appendix A

Statistical measures of household spending produced by the Survey of Household Spending (SHS)

The **average expenditure per household** has always been the basic statistic published by the SHS. When the survey results are published in *The Daily* or in *Spending Patterns in Canada*, the analysis focuses on averages per household.

Annual averages (arithmetic means) are calculated and published for total expenditures, summary-level expenditures and detailed expenditures. These averages are readily compared between years, geographical areas, income quintiles, household types and other variables. They can also be compared between countries once currency adjustments are made.

Answers from all households are included when calculating averages per household. The answers vary by item, but they may range from zero to thousands of dollars. Since there can be a lot of variability between households for a given expenditure item, averages are affected by reported expenditures that are very high or very low.

Averages per household are additive. If averages for individual items are summed, they will equal the average for total expenditures. For example, the average 2003 expenditures per household for food (\$6,785), shelter (\$11,582) and clothing (\$2,435) can be added together to get \$20,802 for these basic items.

The **budget share** or **percentage of total expenditures** has also been an important statistic over the years. Since averages per household are additive, it is easy to calculate expenditures for given items as a percentage of total expenditures. These percentages are readily compared between years, geographical areas, income quintiles, household types and other variables. The budget share is also used for making international comparisons, since it is independent of currency or length of the reference period (e.g., year or week). This statistic is additive. For example, the 2003 budget shares for food (11%), shelter (19%) and clothing (4%) can be added together to get 34% for these three basic items.

Percentage reporting has also been published for many years. It is important to know the percentage of households reporting expenditures for a given item. For certain basic items like food, this percentage will be about 100%. For other items, the percentages will vary between years, geographical areas, income quintiles, household types and other variables. This statistic is non-additive.

The **average expenditure per household reporting** has also been an important statistic. This statistic is particularly useful for studies that focus on specific expenditure items, such as rent, vehicle purchases and child care. It is non-additive.

Aggregate expenditures have been published for many years although the demand for them is less than the demand for the averages per household. It is important to calculate total spending by item and by classification category. Aggregates are very flexible because they are additive. For example, the 2003 aggregates at the Canada (10 provinces) level for food (\$80 billion), shelter (\$136 billion) and clothing (\$29 billion) can be added together to get \$245 billion for these three basic items. National Accounts and Prices Division are key users of the aggregate data.

Market shares can be calculated from the aggregates for specific expenditure items. For example, aggregate 2003 expenditures on clothing were \$29 billion, and households in the highest income quintile spent \$12 billion, so their market share would be approximately 40%.

Coefficients of variation (CVs) have been calculated and released for some estimates over the years. At the present time, CVs for averages per household are published in the *User Guide* for all the detailed items by province.

Estimates are not considered to be reliable and should therefore be suppressed when the CVs are more than 33%. Rough estimates of CVs for any estimate can be calculated from a special formula that is based on known CVs and the number of households reporting. In general, estimates should be suppressed when the number of reporting households is less than 30.

Appendix B

Statistical measures of household spending produced by other countries

The **United States** Bureau of Labor Statistics publishes household spending estimates from the Consumer Expenditure Survey. The average annual expenditure per consumer unit is the basic statistic used in their main publication. There are several tables of averages for the summary items which have been classified by a number of categories. They also release tables with budget shares, aggregates, aggregate (market) shares and standard errors (including CVs).

American researchers use medians for special studies. For example, the National Research Council's Panel on Poverty and Social Assistance has proposed a new approach for measuring poverty - median expenditure estimates for food, shelter and clothing are used in the calculation of this proposed measure.

The U.S. Census Bureau has published papers using median estimates of housing costs from 2000 census data. Medians that are used in the report on renters are based on households living in renter-occupied units who pay cash rent, excluding one-family households on 10 or more acres.

In the **United Kingdom**, the Office for National Statistics publishes annual household spending estimates from the Expenditure and Food Survey. Average weekly expenditure per household data are presented and analyzed using a variety of classification categories, such as income deciles and age of the reference person. The proportions of total expenditure (budget shares) are given for all households and they are used extensively for comparing the spending patterns of various groups. CVs are also published. The survey is the major source of consumer expenditure estimates for the National Accounts, so aggregates are being produced. The United Kingdom does not publish median expenditures.

The Household Expenditure Survey is the source of statistics on household spending in **Australia**. Statistics are currently being collected and published every five years. The average weekly expenditure per household is the key statistic in the publication. It is sometimes supplemented by percentage of total expenditure (budget share) estimates. Other statistics may be available, but they are not in the main publication. Australia does not publish median expenditures.

New Zealand conducts the Household Economic Survey every three years. Average household expenditure per week is their key statistic. It is supplemented by statistics on aggregate annual expenditure, percentage of households reporting expenditures, expenditures as a percentage of total expenditure (cents per dollar of expenditure), and the sample error (CV). New Zealand does not publish median expenditures.

In 2003, the **17th International Conference of Labour Statisticians** was held in Geneva. The final report of the conference recommends that countries publish estimates of average and median income and expenditure statistics when appropriate. When households report zeros and negative values, their answers should be included in the calculation of means and other statistics.