Annotated Research Report

Contents
1. Annotated example of a MEDSCI Research Report.
2. Guidelines about report writing, with examples from the Research Report.

Annotation key

<table>
<thead>
<tr>
<th>Tentative claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong claims</td>
</tr>
<tr>
<td>Transition signals</td>
</tr>
<tr>
<td>Specialised vocabulary</td>
</tr>
</tbody>
</table>

Please note that this paper can be used by teaching staff as a teaching resource provided that acknowledgement is given. It can also be used by students as a self-study tool; however, the text cannot be copied and used in students’ assignments. Copyright for the original assignment texts remains with the students who wrote them.
As this example shows, the **title** of a research report provides an overview of the research to be reported on, the participant(s), and the purpose and type of study.

The **introductory or topic sentence** of this first paragraph not only introduces the topic of the initial paragraph, but also the importance of the research.

Note the way that the writer skilfully connects one sentence to another using the **connectors** "indeed" (to introduce evidence of the significance of the Mediterranean diet) and “furthermore” (to introduce further research evidence).

See the extensive use of the **passive voice** in the first paragraph (apart from the second sentence) and in the introduction section. The passive is used so that the **focus** of each sentence is on the **findings** of research being reported on rather than the name of the studies or the researcher(s) carrying out the studies.

Adherence to a Mediterranean diet has been associated* with a reduction in the prevalence of **cardiovascular** disease. Indeed, the **PREDIMED** study found that the consumption of a Mediterranean diet reduced the relative risk of individuals suffering a major cardiovascular event (e.g. stroke, myocardial infarction) by 30%. Furthermore, a number of trials have indicated that the Mediterranean diet is associated with a 30-70% reduction in the recurrence of cardiovascular events following **myocardial infarction** or **stroke**. The underlying mechanisms mediating primary and secondary prevention of coronary heart disease by the Mediterranean diet, however, have been incompletely elucidated.

The term ‘Mediterranean diet’ refers to the nutritional habits that permeated Crete, Greece and Southern Italy during the early 1960s. It is characterized by the high consumption of monounsaturated fat rich olive oil, omega 3 fatty acid rich fish, fruit, vegetables, brown rice and bread, the

Note that full sentences are not required when writing the **title** of a research report. Also, note that titles are often written in **two parts** with one phrase counterbalanced by another that gives additional information. These two phrases are joined by a colon.

The first section of a research report is the **Introduction**. The main purpose of this section is to **introduce** and highlight the importance of the **research topic**, provide background to the research, **review** the relevant **literature**, identify the **gap** in the research to be addressed, provide the **rationale** for the research, and briefly describe the **methodology**.

Here, the writer gives a clear, succinct **definition** of the term “Mediterranean diet”. Introducing this term early in the paper was important because understanding its meaning is central to understanding of the entire paper.
consumption of alcohol and the low consumption of dairy products, red meat and processed foods. This is markedly different from the Western diet predominant in countries such as New Zealand which is characterized by high levels of saturated fats and simple carbohydrates.

Poor autonomic function is a well-established risk factor for cardiovascular disease. The Framingham Heart study determined that a one-standard deviation diminution in the SDNN, the standard deviation for all of the normal RR intervals, was associated with a 47% increase in the risk of suffering from a major cardiovascular event. Furthermore, in patients who had already experienced a myocardial infarction, subnormal HRV was associated with a three- to four-fold increase in the 2.5 year mortality rate. Additionally, high heart rates and hypertension have both been associated with increased cardiovascular mortality. Therefore, identifying mechanisms by which to improve cardiac autonomic control is essential.

Recently, evidence has emerged suggesting the Mediterranean diet has the capacity to improve autonomic function. Assessing autonomic function requires examining both the tonicity and reactivity of the sympathetic and parasympathetic nervous systems.
branches of the autonomic nervous system each have a tonic level of activity. Chronic sympathoexcitation has been linked with a number of cardiovascular conditions including hypertension and heart failure.\(^8\)

Ascertaining mechanisms by which to shift the autonomic system to a more parasympathetic-dominated tone, either by reducing tonic sympathetic or increasing tonic parasympathetic activity, has become a particularly active area of research.\(^8\)

Evidence suggests the Mediterranean diet is capable of inducing this shift. Long-term and short-term adherence to the Mediterranean diet is inversely associated with systolic and diastolic blood pressure as evidenced by results from the PREDIMED trial and EPIC study.\(^9,10\) Additionally, the SUN project demonstrated that heart rate is inversely associated with long-term adherence to the Mediterranean diet.\(^11\)

Long-term adherence to the Mediterranean diet has also been associated with improved autonomic reactivity. Autonomic reactivity refers to the extent to which an individual responds to different stimuli such as a fall in blood pressure.\(^7\) Results from the Twin Hearts Study showed a significant positive association between Mediterranean diet consumption and heart rate variability (HRV).\(^12\) Perhaps most notable was the difference in the pNN50, with scores of 1.73% and 2.18% in those with low and high adherence to the Mediterranean diet respectively.\(^12\)
Whilst a number of studies have examined the impact of long term adherence to the Mediterranean diet on autonomic function, there is a paucity of data with respect to the immediate consequences of such a dietary intervention. Obtaining an understanding of the time required for a Mediterranean diet to begin to induce cardioprotective changes in autonomic function will provide us with an insight into the mechanisms by which it mediates the aforementioned changes. Additionally, many of the recent trials examining the impact of the Mediterranean diet on cardiovascular health have taken place in countries where the baseline adherence to the Mediterranean diet is high. Additionally, it is important to ascertain the effect of Mediterranean mediated dietary intervention in countries with a Western diet. Our study sought to assess the impact of a 19-day Mediterranean diet on both autonomic tonicity and reactivity on a 20 year old male who primarily consumes a Western diet.

Methods

Mediterranean Diet

Our subject was a healthy 20 year old male. The subject obtained nutritional information made available through the PREDIMED trial website to assist with dietary manipulation. Adherence to the Mediterranean diet was assessed using...
two separate scoring systems. A 14-item questionnaire used in the PREDIMED trial was used because it had shown a strong correlation with longer, more time consuming questionnaires traditionally used. Additionally, the modified Mediterranean diet scoring system was used because this scoring system was deliberately constructed to assess the transition from a more Westernized diet to a Mediterranean diet.

Assessment of Autonomic Tone

Resting heart rate (RHR) values were measured using an ECG whilst the subject sat stationary for 10 minutes. Calculation of the pNN50% and pNN40% was performed using data obtained during this phase of the experiment. Resting blood pressure values were recorded using a sphygmomanometer. Systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MBP) were all recorded.

Assessment of Autonomic Reactivity

Mental Stress – Heart Rate was recorded for 1 minute prior to the onset of the mental stress challenge. The subject was then subjected to a series of difficult mathematical questions for 5 minutes. The difference between the average heart rate recorded during the 5 minute mental stress period and the baseline heart rate was recorded.
Respiratory Sinus Arrhythmia – The subject was asked to inhale and exhale in 10 second cycles. The **RSA amplitude** was determined by examining the difference between the peak heart rate during inhalation and the lowest heart rate following exhalation.

Postural Change – The change in heart rate during a movement from supine to standing position was assessed in our subject. The **Peak:Baseline** ratio was calculated by dividing the highest heart rate recorded during the postural change by the average heart recorded in the 30 seconds preceding postural change. The 30:15 ratio was calculated by dividing the value of the longest R-R interval at heart beat 30 following standing by the shortest R-R interval at beat 15 following standing.\(^{15}\)

Valsalva Manoeuvre – The subject was asked to blow against a closed glottis through a mouthpiece with an **expiratory** pressure of 5kPa (37.5mmHg) for 15 seconds. The **Valsalva** ratio was calculated by dividing the longest R-R interval obtained during Phase IV by the shortest R-R interval obtained during Phase II or III.\(^{16}\) The **tachycardia** ratio was calculated by dividing the shortest R-R interval obtained during expiration by the longest R-R interval measured in the 30 seconds prior to expiration.\(^{16}\) The Phase IV overshoot was obtained by finding the difference between the peak systolic pressure prior to Phase I and the peak systolic pressure during Phase IV. Additionally, the change in heart rate from the beginning to end of both Phase II and Phase IV were assessed.

Dive Reflex – The subject underwent facial immersion in cold water with a temperature of 15°C for 30 seconds. Heart Rate was recorded for the 30 seconds prior to immersion and during the recovery. Average heart rate values were determined for 30 seconds pre-dive, 0-15 seconds during the dive, 15-30 seconds during the dive, and the 30 seconds post-dive. These values were then compared to assess the magnitude and speed of the response.

Comparison of data

Several trials for each variable were conducted pre-diet and post-diet to enable an assessment of the effect of the 19-day Mediterranean diet on autonomic reactivity.
Results

Degree of Dietary Intervention

Two separate questionnaires confirmed the degree of adherence to the Mediterranean diet. A summary is given in Table 1. See Appendix 1 for details of each scoring system.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Diet</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREDIMED Diet Score</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>mMDS</td>
<td>23</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 1: The subject’s diet during dietary intervention was considerably more Mediterranean than prior to the initiation of the diet. The PREDIMED Diet Score has a maximum score of 14. The Modified Mediterranean Diet Score (mMDS) has a maximum score of 44.

Heart Rate, Blood Pressure and Heart Rate Variability

Our subject saw a small drop in heart rate and an increase in heart rate variability after the dietary intervention. A summary is shown in Table 2. There was also a small drop in systolic blood pressure and mean blood pressure. Our subject’s weight did not change through the 19 day intervention period.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Diet</th>
<th>Post-Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHR (bpm)</td>
<td>91.05</td>
<td>87.1</td>
</tr>
<tr>
<td>pNN50%</td>
<td>1.68</td>
<td>2.44</td>
</tr>
<tr>
<td>pNN40%</td>
<td>4.27</td>
<td>5.27</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>149</td>
<td>144</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>83</td>
<td>74</td>
</tr>
<tr>
<td>MBP (mmHg)</td>
<td>116</td>
<td>109</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>70.5</td>
<td>71</td>
</tr>
</tbody>
</table>
Table 2: Summary illustrating changes in heart rate, heart rate variability, blood pressure and weight following dietary intervention.

Mental Stress

The average increase in heart rate in response to the 5 minute mental stress challenge was not notably different following dietary intervention as is illustrated in Figure 1. There was a 6.98bpm and a 7.75bpm increase in heart rate pre-diet and post-diet respectively.

Figure 1: RSA amplitude and the increase in heart rate in response to mental stress did not change during dietary intervention. Data represents mean ± standard deviation.

Respiratory Sinus Arrhythmia

The amplitude of respiratory sinus arrhythmia (RSA) did not change with dietary intervention. Indeed, the values were near-identical with amplitudes of 10.27bpm and 10.73bpm recorded pre-diet and post-diet respectively.

Baroreflex Activity

Baroreflex mediated changes in heart rate in response to changes in blood pressure were assessed in a range of different tests. The sympathetic response to low blood pressure was examined using two separate tests with conflicting results. The increase in heart rate as a subject moved from the supine position to standing was less after dietary intervention. The ratio of peak heart rate to baseline heart rate was higher pre-diet than post-diet with ratios of 1.34 and 1.27 respectively.

However, there was a larger increase in heart rate in response to low blood pressure during phase II of the Valsalva manoeuvre after dietary intervention as illustrated in Table 4. However, the tachycardia ratio was identical pre-diet and post-diet. The discrepancy between these two results likely reflects differences in the phase I drop in heart rate which was highly variable both pre-diet and post-diet. Additionally, the phase IV overshoot pre-diet and post-diet were very similar. Thus, the impact of dietary intervention on the response to low blood pressure is unclear.

The response to increased blood pressure was also assessed. The 30:15 ratio assessed during postural change was identical pre-diet and post-diet as illustrated in Table 3.
The Valsalva ratio and decline in heart rate during phase IV of the Valsalva manoeuvre were substantially larger following dietary intervention. It should also be noted that the variation in the primary Valsalva measurements was considerably larger post-diet.

Dive Reflex

There was a markedly larger decrease in heart rate during the first 15 seconds of the dive phase after dietary intervention as illustrated in Table 5. However, there was substantial overlap in the heart rate recorded during the second 15 seconds between the pre-diet and post-diet trials.

Table 4: Changes in the primary variables assessed during the Valsalva manoeuvre following dietary intervention. Data represents mean ± standard deviation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Diet</th>
<th>Post-Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valsalva Ratio</td>
<td>1.71 ± 0.05</td>
<td>2 ± 0.20</td>
</tr>
<tr>
<td>Tachycardia Ratio</td>
<td>0.75 ± 0.02</td>
<td>0.75 ± 0.04</td>
</tr>
<tr>
<td>Phase IV Overshoot (mmHg)</td>
<td>43.07 ± 2.72</td>
<td>43.91 ± 10.96</td>
</tr>
<tr>
<td>ΔHR Phase IV (bpm)</td>
<td>-42.91 ± 2.18</td>
<td>-51.03 ± 6.46</td>
</tr>
<tr>
<td>ΔHR Phase II (bpm)</td>
<td>24.53 ± 2.91</td>
<td>30.16 ± 4.57</td>
</tr>
</tbody>
</table>

Table 5: Difference between the average pre-dive heart rate and the average heart rate measured during the first and second 15 seconds of the dive period. Data represents mean ± standard deviation.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Pre-Diet</th>
<th>Post-Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔHR from baseline (bpm)</td>
<td>2.36 ± 8.91</td>
<td>-8.77 ± 6.46</td>
</tr>
<tr>
<td>0-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-30</td>
<td>-8.95 ± 4.35</td>
<td>-13.72 ± 2.52</td>
</tr>
</tbody>
</table>

Interestingly, the average pre-dive and post-dive heart rate was similar in both the pre-diet and post-diet recordings as illustrated in Figure 2. The return to pre-dive heart rate was also faster post-diet.
The Discussion section is perhaps the most challenging section to write because the writer needs to interpret his/her results in relation to what has already been found in previous studies. This section closely links to the Introduction because it answers the question or responds to the hypothesis that was raised (see the last paragraph of the Introduction to find the research gap and purpose of this study). This section also explains how the research has moved understanding about the research area forward (cf. Bates College, 2011).

**Discussion**

**Autonomic Tone – Blood Pressure**

The Mediterranean diet resulted in a shift to a more parasympathetic-dominated autonomic tone in our subject. This was evidenced by the 4bpm drop in resting heart rate and the 5mmHg drop in systolic blood pressure observed in our subject after dietary intervention. Both of these measures, however, are static indices which solely provide an indication as to the net autonomic impact on the cardiovascular system. It is therefore not clear whether this shift was mediated by a diminution in sympathetic nerve activity or by an augmentation of parasympathetic activity.

Our drop in systolic blood pressure is more pronounced than expected although not entirely without precedent. Results from the PREDIMED trial revealed that one year following dietary intervention, the average systolic blood pressure of participants on average dropped by 1-3mmHg. Whilst our subject’s drop was larger than this, this...
is not surprising. The majority of participants in the PREDIMED trial, however, had a baseline diet that was similar to the Mediterranean diet used in the study. Indeed, the baseline adherence level on average was 8.6 to 8.8 out of 14, approximately 6 points higher than our subject’s baseline diet. The level of dietary adherence was approximately 10.6 following dietary intervention, representing a 2.2 to 2.8 increase in Mediterranean diet adherence. The Mediterranean diet adherence score was similar to our subject’s during the trial. Thus, the more pronounced drop in systolic blood pressure observed in our experiment likely reflects the higher degree of dietary modification our subject experienced. An additional reason for the difference might reflect the average age of the participants. Participants in the PREDIMED trial had an average age of 67 whereas our subject was a 20 year old male. The younger age might also have facilitated the greater responsiveness. One noteworthy feature of our results was the time-frame under which they were achieved. The dramatic change in diet our subject underwent was capable of influencing blood pressure and heart rate in the short-term.

The precise mechanisms by which the Mediterranean diet mediates a fall in blood pressure remain unclarified. Whilst a number of the individual components...
of the Mediterranean diet have been shown to reduce blood pressure, the specific biochemical pathways involved are still being elucidated. For example, the preferential consumption of foods with a low glycemic index (brown rice, brown bread, no sweet deserts) is associated with reduced systolic blood pressure. High blood glucose levels are associated with enhanced O-linked N-acetylglicosaminylation of endothelial nitric oxide synthase (eNOS) leading to a reduction in nitric oxide (NO) production and hence heightened sensitivity to vasoconstrictive stimuli such as norepinephrine. It is thus feasible that the reduced consumption of glucose and other simple carbohydrates by our subject facilitated heightened NO production in the vasculature and hence a reduced blood pressure. Furthermore, the increased consumption of olive oil, monounsaturated fatty acids, omega-3 fatty acids and fruit and vegetables and the reduced consumption of red meat have all been shown to independently reduce systolic blood pressure.

Interestingly, heightened levels of docosahexaneoic acid (DHA) have been shown to significantly reduce the response of the forearm vasculature to heightened sympathetic norepinephrine release. This suggests there is some commonality in terms of the location of the hypotensive inducing effect of various components of the Mediterranean diet, even if the precise signalling pathways are distinct. The changes in blood pressure induced by each component of the diet individually are usually small and in the vicinity of a 1-2mmHg reduction. Thus, it is clear that multiple components of the Mediterranean diet interact, probably synergistically, to lower blood pressure. It is also important to note that our subject did not experience a change in weight. This is significant because a drop in weight is often associated with a reduction in blood pressure.

**Autonomic Tone – Heart Rate**

The drop in blood pressure in our subject was likely partially mediated by the drop in heart rate. Only one study has been published investigating the relationship between heart rate and the Mediterranean diet. The SUN project found that individuals with a high adherence to the Mediterranean Diet (a score of 7-9 out of 9 on their scoring system) had on average a 2.2bpm lower heart rate than individuals with a low adherence (0-2). Whilst our drop in heart rate might seem large when this study is considered, there are two important factors to keep in mind. The SUN project did not examine the impact of a change in diet and only compared heart rate with an individual's existing diet. It would not be surprising if the impact of a change in diet was more pronounced than 2.2bpm given the potential role of psychological factors and the placebo effect. It is difficult to
determine the impact that a subject’s perception of the health value of their diet has on the final results. Our subject did note that he felt like he had a “greater sense of overall wellbeing” as a result of consuming the diet. Additionally, there was substantial overlap in the range of heart rates recorded during the SUN project. Individuals with a low adherence to the Mediterranean diet had an average heart rate of 69.1 ± 10.4bpm whereas those with a high adherence had an average heart rate of 66.9 ± 10bpm. Given this degree of overlap, a 4bpm drop in resting HR is not infeasible.

There are a range of factors that could have contributed to the drop in heart rate in our subject. Increased DHA consumption as a result of the increased fish intake could have contributed. Kang et al. have demonstrated that incorporation of DHA into the membranes of cardiomyocytes results in a reduction in excitability and automaticity. A recent cross-sectional study demonstrated that heart rate is approximately 1.6bpm lower in moderate alcohol drinkers than in individuals who [do not] drink or drink heavily. This is notable as one of the starkest changes in diet for our subject was the transition from not drinking wine to having one glass a day. However, it is not possible to isolate the specific dietary components that mediated the shift in autonomic tone. It is interesting to note, however, that our subject’s vegetable and nut consumption did not increase during the diet. Both of these are traditionally seen as key components of the Mediterranean diet and have been shown to enhance a shift to a more parasympathetic favourable autonomic tone. Our results suggest that, at least in our subject, neither is absolutely required to mediate the drop in blood pressure or heart rate. It is also worthy of note that whilst the subject’s fruit consumption increased, this was not picked up by either of our scoring systems because the threshold fruit consumption was met pre-diet and post-diet.

**Autonomic Reactivity - HRV**

The results regarding the influence of the Mediterranean diet on our subject’s autonomic reactivity were inconclusive and in some cases conflicting. The HRV as measured by the pNN50 and pNN40 increased. Our decision to measure the pNN40 as well as the pNN50 reflected recent evidence indicating that lower values of x in pNNx tests were better at discriminating the autonomic function between two separate groups. Our subject’s results for the pNN50 and pNN40 increased following dietary intervention indicating our subject had an increase in HRV. Higher values of HRV are generally considered to reflect heightened parasympathetic modulation of autonomic tone. This reflects the reality that parasympathetic nervous system can regulate heart rate on a beat
by beat basis due to the rapid activity of acetylcholinesterase which is present at the synaptic cleft in high concentrations. Sympathetic activity, however, mediates changes over a slightly longer time period. Our results were consistent with the findings of the Twin Hearts Study. They found that individuals with a low adherence to the Mediterranean diet (score of 0-3 out of 9 in their scoring system) had a pNN50 of 1.73% whereas individuals with a high adherence to the Mediterranean diet (score of 6-9) had a pNN50 of 2.18%. Our subject saw their pNN50 increase from 1.68% to 2.44% post-diet. However, this comes with the obvious caveat that our HRV was only measured over a 10 minute resting stationary period.

Autonomic Reactivity – Baroreflex

Intriguingly, the shift in our subject’s autonomic reactivity following dietary intervention appeared to be stimulus dependent. This was most evident in our assessment of the subject’s autonomic baroreflex control. Our subject’s response to a stimulus of low blood pressure was either reduced or unchanged post-diet depending on the test performed. Our subject’s heart rate response following a change in posture from supine to standing was diminished whereas the tachycardia ratio and Phase IV overshoot observed during the Valsalva manoeuvre was unchanged post-diet. Both of these measures assess the cardiac response to transient low blood pressure. Taken in concert, these results suggest that the response to low blood pressure stimuli, which reflects a combination of sympathetic activation and vagal withdrawal, was slightly diminished post-diet.

A similarly conflicting pattern of results were observed with regards to our subject’s response to high blood pressure. Whilst the 30:15 ratio assessed during postural change was unchanged, the Valsalva ratio and absolute change in heart rate during Phase IV of the Valsalva manoeuvre were increased. The lack of a difference in the results for the 30:15 ratio might reflect the difficulty in precisely locating the 15th and 30th heart beat post- standing. Taken together, these results
suggest that the autonomic response to high blood pressure stimuli, which reflects a combination of parasympathetic activation and sympathetic withdrawal, was slightly enhanced post-diet.\(^8\) Whilst this is admittedly speculative, the coupling of a heightened response to high blood pressure with a diminished response to low blood pressure, is perhaps indicative of a shift in the baroreflex stimulus-response curve to the left. This would be consistent with the drop in systolic and diastolic blood pressure observed in our subject post-diet. Whilst dietary changes in salt intake have been shown to be capable of inducing a shift in the baroreflex curve, there is a paucity of research examining the link between other dietary modifications and the aforementioned shift.\(^32\) It should be noted that our subject’s salt intake was not deliberately altered during the experiment. However, the reality that several of the variables measuring the autonomic response to the baroreflex did not change post-diet hinders our capacity to draw a firm conclusion.

**Autonomic Reactivity – Mental Stress and RSA**

The autonomic response to mental stress and RSA did not change dramatically following dietary intervention. Whilst the RSA amplitude and increase in heart rate associated with mental stress were slightly increased post-diet, the differences were small and likely reflect natural variation. The heart rate response to mental stress is thought to result from a range of stimuli, most notably cognitive input from the cerebral cortex to the cardiovascular control centre in the brainstem.\(^16\) Whilst our subject’s response to the mental stress did not change, it should be noted that the reliability of this test as an index of sympathetic activity is limited by the need to provide stimuli that should induce a consistent level of mental stress. Whilst the degree of difficulty of the mathematical questions asked of our subject did not change, the number of individuals present and observing the study was higher during the pre-diet assessment than the post-diet assessment. This might have artificially inflated the heart rate response to mental stress observed pre-diet.

RSA is mediated by input from the central respiratory centre to the nucleus ambiguus and the inhibition of efferent cardiac vagal nerve activity following lung inflation.\(^33\) In our subject the RSA amplitude was unchanged post-diet, perhaps suggesting that the degree of parasympathetic withdrawal during inhalation was not affected by the Mediterranean diet.

**Autonomic Reactivity – Dive Reflex**

The dive reflex is a common tool used to assess autonomic function. It is often used to assess trigeminal-brainstem-vagal activity. The drop in heart rate observed in our subject during the first 15
seconds post-diet might simply reflect the subject becoming increasingly accustomed to the facial immersion. Interestingly, there was substantial overlap occurring between the average heart rates recorded during the second fifteen seconds of the dive pre-diet and post-diet suggesting that the diet had a limited impact on the overall magnitude of the parasympathetic response to the dive reflex.

**Limitations**

The most pertinent limitation in our experiment is the participation of only one subject and the lack of a placebo-control group. It is not possible to extrapolate data obtained from one individual and apply it to the population at large. Our subject was a healthy 20 year old, normal weight, non-smoking male. The response to the Mediterranean diet is likely to be substantially affected by age, gender, the original baseline diet, the presence of co-morbidities, weight, the use of anti-hypertensive drugs, smoking, waist circumference, exercise frequency and a range of additional factors. None of these factors can be controlled for in a study involving one individual.

Our study also lacked a placebo group. Whilst the high level of consistency observed pre-diet and post-diet across several measured autonomic tests adds weight to the idea that changes in the Valsalva ratio and suchlike were potentially mediated by the dietary
changes, the presence of a placebo group would have provided an indication as to whether the changes in the autonomic test scores obtained by our subject were the result of natural variation.

Another limitation was that a number of the tests we were using to assess autonomic activity, whilst are commonly used in the clinic to assess a range of conditions, have not previously been used to assess the impact of the Mediterranean diet on autonomic function. Therefore, it was difficult and in some cases impossible to assess whether our data was consistent with what had been observed elsewhere.

Our study also illustrates the most significant limitation of dietary intervention as a therapeutic tool. An individual’s preference for specific food groups has a major impact on the capacity to adhere to a Mediterranean diet. For example, our subject did not consume nuts or increase his consumption of vegetables such as tomatoes during the diet. Thus, our subject only managed to achieve a dietary adherence score of 11 out of 14. Ideally, our subject would have achieved a score of 14.

Thus, no firm conclusions can be drawn from our study with respect to the potential benefits of the Mediterranean diet on the rest of the population. It does, however, as many case study reports do, provide insight into potential areas for future research. Much, but not all, of the literature in recent years has been focussed on studies (e.g. the SUN...
project, PREDIMED trial and the EPIC study) in which the base population lived in Europe where adherence to the Mediterranean Diet is high. Our study therefore acts as a reminder that more data, similar to that acquired during the Lyon Heart Study, is required to ascertain the impact of the transition from a Western to a Mediterranean diet on autonomic function and cardiovascular control. This is imperative given the high prevalence of cardiovascular disease in societies with a Western diet.

Conclusions

Consumption of a Mediterranean diet for 19 days by our subject resulted in a shift to a more parasympathetic-dominated autonomic tone. However, the impact on autonomic reactivity was inconclusive with a range of conflicting results. Results from our study highlight the need for more Mediterranean diet-based studies to be performed in populations with a baseline Western diet.

References


26. Kang JX, Leaf A. Protective effects of free polyunsaturated fatty acids on arrhythmias induced by lysophatidylcholine or


Appendix 1: Adherence to Mediterranean Diet

Shown below is the 14-item Mediterranean Diet Assessment tool used to assess our subject’s degree of dietary adherence. More detailed information regarding the scoring system and specific serving portions has been published previously.\(^{33}\)

Our subject had a score of 3 prior to commencement of the diet and 11 during the diet.

Table 1: Adherence to the Mediterranean Diet: A 14-item Validated Assessment Model

<table>
<thead>
<tr>
<th>Questions</th>
<th>Criteria for 1 point</th>
<th>Pre-Diet</th>
<th>During Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you use olive oil as the main culinary fat?</td>
<td>Yes</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How much olive oil do you consume per day?</td>
<td>≥4 tbsp</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many vegetable servings do you consume per day (1 serving: 200g)?</td>
<td>≥2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many fruit units do you consume per day?</td>
<td>≥3</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many servings of red meat, hamburger or other meat products do you consume per day?</td>
<td>&lt;1</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many servings of butter, margarine, or cream do you consume per day (1 serving: 12g)?</td>
<td>&lt;1</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many sweet or carbonated beverages do you consume per week?</td>
<td>&lt;1</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many servings of fish or shellfish do you consume per week (1 serving: 100-150g)?</td>
<td>≥3</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many times per week do you consume commercial sweets or pastries?</td>
<td>&lt;3</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How much wine do you drink per week?</td>
<td>≥7</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many servings of nuts do you consume per week (1 serving: 30g)?</td>
<td>≥3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you preferentially consume chicken, turkey or rabbit meat instead of veal, pork, hamburger or sausage?</td>
<td>Yes</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>How many times per week do you eat dishes seasoned with sofrito?</td>
<td>≥2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many servings of legumes do you consume per week (1 serving: 30g)?</td>
<td>≥3</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

X = achieved.
Our subject’s adherence to the Mediterranean diet was also confirmed using the Modified Mediterranean diet score. More detailed information regarding the scoring system and specific serving portions has been published previously.\textsuperscript{34}

A summary of our subject’s score is illustrated below. A score is given for each category depending on the degree of adherence to the Mediterranean diet achieved. For example, if your primary wheat consumption is of brown bread/rice you receive a score of 4, if you primarily consume white bread, you receive a score of 0.

Table 2: Modified Mediterranean Diet Score

<table>
<thead>
<tr>
<th>Category</th>
<th>Pre-Diet</th>
<th>During Diet</th>
<th>Maximum Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast-food consumption</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Fruit and Vegetables</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Sweet Deserts</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Primary Fat</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Secondary Fat</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Fried Food consumption</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Bread consumption</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Fish consumption</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Alcohol Consumption</td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Fluid with meals</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
<td><strong>40</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>
MEDSCI Research Reports

Background to this research report

The above research report was written by a student for a laboratory group assignment for a MEDSCI course. There were four members in this student’s group who designed the research project and collected the data together before each of them individually wrote up and submitted their own reports. The student who wrote this report was the sole subject of the trial.

Sections of research report

As this example illustrates, scientific research reports based on experimental work follow a very specific format and often include the following sections: Introduction, Methods, Results, Discussion, Conclusions, and References. Each section is written in a distinct way with variations, for example, in tense usage, hedging devices (through which tentative claims are made), and active and passive voice.

Because there are so many variations in the content of research reports, it is vital that you follow the course guidelines about expectations of the sections to be included, referencing style, formatting and length of each section. You will see that in this example, the first three sections (Introduction, Methods and Results) are of a similar length, whereas the Discussion section is much longer and the Conclusions is very short. Below is a brief overview of each section:

Introduction
The main purpose of the Introduction is to introduce and highlight the importance of the research topic, provide background to the research, review the relevant literature, identify the gap in the research to be addressed, provide the rationale for the research, and briefly describe the methodology. In addition, Glasman-Deal (2010) observes that at the very end of the Introduction, the writer can announce the findings (p. 23).

Methods
The Methods section describes and provides details of the procedures that were followed in the study to collect and analyse data.

Results
The Results section describes what was found or observed in the study. Results are often presented visually in tables or figures and accompanied by explanatory text.

Discussion
The Discussion is perhaps the most challenging section to write because the writer needs to interpret his/her results in relation to what has already been found in previous studies. This section closely links to the Introduction because it answers the question or responds to the hypothesis that was raised (see the last paragraph of the Introduction to find the research gap and purpose of this study). The Discussion also explains how the research has moved understanding about the research area forward (cf. Bates College, 2011).

Limitations
As this example shows, the Discussion can also include reference to the limitations of a study, which Glassman-Deal (2010) observes opens up possible avenues for future research. Reference to the limitations of a study can be made in the Methods, Results and Discussion. Identifying the limitations of a study shows that you are able to evaluate your research and see its shortcomings (Glassman-Deal, 2010).

Conclusions
The Conclusions is the briefest section of the research report. This section gives the writer the opportunity to sum up the main findings and highlight the possibilities of future research.
Distinctive language features of research reports

Research reports have a number of distinctive language features, which are outlined below:

Pronoun usage

One distinctive feature of research reports is related to the use of pronouns. You will see that in this report the pronoun "our" is used to refer to the subject of the study. The plural pronoun is used in this research report because the study was carried out by a group of students, who each reported on it individually; e.g.,

Our subject was a healthy 20 year old male. (First mention in Methods).

Parallelism

A further language feature is the use of parallelism, which means that the same grammatical pattern is used in lists or comparisons. The writer skilfully uses parallelism in this report, which makes it easier for the reader to follow the argument; e.g.,

It is therefore not clear whether this shift was mediated by a diminution in sympathetic nerve activity or by an augmentation of parasympathetic activity.

Expressing an opinion or the author's "voice"

As you can see in the above report, it is possible for the writer to position themselves and express their opinion through their choice of language. Writers can make tentative claims by using "hedging" devices (e.g., perhaps, suggest) or strong claims (e.g., markedly) when they are certain about the point they are making. Further, writers can comment on something interesting (e.g., interestingly, intriguingly) by using adverbs.

Tentative claims

Tentative claims or "hedging" are made most frequently in the Discussion section of this research report. Frequent use of hedging is made here because the writer needs to interpret the results of his study in light of previous research and he may not be certain of the claim he is making. The writer either uses adverbs (likely, slightly), verbs with a weak meaning (suggest, seem), or modal verbs (could, might, can) or a combination of these to express uncertainty:

An additional reason for the difference might reflect the average age of the participants.

Whilst our drop in heart rate might seem large when this study is considered, there are two important factors to keep in mind.
Hedging is used less frequently in the other sections of this research report. Indeed, in this paper, there are just two examples of hedging in the Introduction where the writer is interpreting the results of previous studies:

Evidence suggests the Mediterranean diet is capable of inducing this shift.

Perhaps most notable was the difference in the pNN50, with scores of 1.73% and 2.18% in those with low and high adherence to the Mediterranean diet respectively.

There are no examples of hedging in the Methods where the writer is just explaining what they did and one in the Results where the writer is interpreting the findings:

The discrepancy between these two results likely reflects differences in the phase I drop in heart rate which was highly variable both pre-diet and post-diet.

**Strong claims**
The writer expresses strong opinions or makes strong claims by using adverbs and nouns with a strong meaning. The author does this for a variety of reasons. First, to express contrast:

This is markedly different from the Western diet predominant in countries such as New Zealand which is characterized by high levels of saturated fats and simple carbohydrates.

Second to express the gap in the research (in the Introduction):

Whilst a number of studies have examined the impact of long term adherence to the Mediterranean diet on autonomic function, there is a paucity of data with respect to the immediate consequences of such a dietary intervention.

Another way to express the writer’s voice
It is possible for writers to make subjective comments when describing the results by using words (e.g., obviously, surprisingly) and phrases (e.g., in particular, in principle). In this report, the writer skilfully uses adverbs to make subjective comments in the Discussion:

Interestingly, heightened levels of docosahexaneoic acid (DHA) have been shown to significantly reduce the response of the forearm vasculature to heightened sympathetic norepinephrine release.

Intriguingly, the shift in our subject’s autonomic reactivity following dietary intervention appeared to be stimulus dependent.

**Developing a coherent argument**
An important feature of a well-written research report is that it is coherent and well-structured. A variety of strategies can be used to ensure that the ideas are logically connected to one-another. One is to use “transition signals” such as indeed, furthermore, additionally, and therefore:

Additionally, high heart rates and hypertension have both been associated with increased cardiovascular mortality. Therefore, identifying mechanisms by which to improve cardiac autonomic control is essential. (Introduction)

Another is to use a pronoun such as “it”, “this” or “these”. If using a pronoun, however, check that the meaning is clear as in the following example where the pronoun “It” clearly represents “Mediterranean diet”:

The term ‘Mediterranean diet’ refers to the nutritional habits that permeated Crete, Greece and Southern Italy during the early 1960s. It is characterized by the high consumption of monounsaturated fat rich olive oil, omega 3 fatty acid rich fish, fruit, vegetables, brown rice and bread, the moderate consumption of
alcohol and the low consumption of dairy products, red meat and processed foods. (Introduction)

Otherwise, if the meaning of the pronoun is not clear, it is preferable to repeat the noun or use a synonym or a noun phrase, as shown in this example:

Average heart rate values were determined for 30 seconds pre-dive, 0-15 seconds during the dive, 15-30 seconds during the dive, and the 30 seconds post-dive. These values were then compared to assess the magnitude and speed of the response.

A further way of ensuring that the ideas connect from one to another is to use the exact wording of a phrase from one sentence to begin the next sentence:

Long-term adherence to the Mediterranean diet has also been associated with improved autonomic reactivity. Autonomic reactivity refers to the extent to which an individual responds to different stimuli such as a fall in blood pressure.

While this can be an effective way to link ideas together, be careful not to overuse it.

Specialised vocabulary

Another feature of well-written research reports is that specialised vocabulary is correctly used; e.g., “cardiovascular”. According to the Oxford Advanced Learners Dictionary this word is an adjective which means “connected with the heart and the blood vessels”. To use specialised vocabulary well, it is important to use the word’s correct form and use the word in an appropriate collocation; that is, with words that frequently combine together; (e.g., ‘cardiovascular disease’ NOT ‘cardiovascular situation’ or ‘cardiovascular illness’). Given the importance of correctly using specialised vocabulary, you may find it useful to build a glossary and focus on learning these words so that you are familiar with their meaning, the words they collocate with, and the various forms of the word.

Verb usage

Research reports are characterised by frequent shifts in tense (past, present), aspect (perfect and simple and very occasionally progressive) and voice (active and passive). Detailed analysis of verb usage can be found in the annotated comments in the body of the paper. A few general comments are given here.

Verb tenses

Introduction

The present tense is predominantly used in the Introduction, and the past tense is used less frequently. The present tense is used, for example, to:

(1) define terminology:
The term ‘Mediterranean diet’ refers to the nutritional habits that permeated Crete, Greece and Southern Italy during the early 1960s.

(2) present well-established facts
Poor autonomic function is a well-established risk factor for cardiovascular disease.

(3) express the gap in the research:
Whilst a number of studies have examined the impact of long term adherence to the Mediterranean diet on autonomic function, there is a paucity of data with respect to the immediate consequences of such a dietary intervention.
In contrast, the past tense is used to report results from previous studies; e.g.,

Indeed, the PREDIMED study found that the consumption of a Mediterranean diet reduced the relative risk of individuals suffering a major cardiovascular event (e.g. stroke, myocardial infarction) by 30%.

Methodology
The past tense is used throughout the methodology section. This tense is used to signal that something took place in the past; e.g.,

Resting blood pressure values were recorded using a sphygmomanometer.

Our subject was a healthy 20 year old male. The subject obtained nutritional information made available through the PREDIMED trial website to assist with dietary manipulation.

Results
The past tense dominates the results section as the writer presents the results of the study; e.g.,

There was a 6.98bpm and a 7.75bpm increase in heart rate pre-diet and post-diet respectively.

The present tense is used to refer the reader to Tables and Appendices:

The average increase in heart rate in response to the 5 minute mental stress challenge was not notably different following dietary intervention as is illustrated in Figure 1.

A summary is given in Table 1.

The present tense is also used to present acknowledged facts:

The PREDIMED Diet Score has a maximum score of 14. The Modified Mediterranean Diet Score (mMDS) has a maximum score of 44.

Discussion
There are frequent switches between the present and past tense in the Discussion. Reference to the present tense is used, for instance, in the interpretation of the results; e.g.,

Our drop in systolic blood pressure is more pronounced than expected although not entirely without present.

Reference to the past tense is made, for example, when referring to the Results of the current or past studies; e.g.,

The Mediterranean diet resulted in a shift to a more parasympathetic-dominated autonomic tone in our subject.

Results from the PREDIMED trial revealed that one year following dietary intervention, the average systolic blood pressure of participants on average dropped by 1-3mmHG.

Conclusions
The Conclusions switches between the simple past to the simple present:

The past tense is used when describing the overall results of the study:

However, the impact on autonomic reactivity was inconclusive with a range of conflicting results.

The present tense is used when describing the possibilities for future research:
Results from our study highlight the need for more Mediterranean diet-based studies to be performed in populations with a baseline Western diet.

Aspect
Frequent switches from the simple to perfective aspect are made particularly in the Introduction and somewhat in the Discussion and minimally, if at all, in the other sections. The present perfect is used when the action that took place in the past is still of relevance now; e.g.,

Adherence to a Mediterranean diet has been associated with a reduction in the relevance of the cardiovascular disease. (Introduction)

The past perfect is used less frequently. Here it appears in the Methods to compare a questionnaire from a study undertaken in the past with other questionnaires used in the past:

A 14-item questionnaire used in the PREDIMED trial was used because it had shown a strong correlation with longer, more time consuming questionnaires traditionally used.

The progressive aspect is only used once in the research report to emphasise the continuous process of using tests to collect data:

Another limitation was that a number of the tests we were using to assess autonomic activity, whilst are commonly used in the clinic to assess a range of conditions, have not previously been used to assess the impact of the Mediterranean diet on autonomic function.

Active and passive voice
A distinct feature of research reports is related to the use of active and passive voice. The passive voice is used much more in research reports than in essays. The writer chooses whether to use the active or passive voice depending on what is being said and where the focus is to be.

When the active voice is used, the subject of the sentence is the doer or performer of the action, and the object is the receiver of the action. The active voice is used in the following example from the Introduction because the writer wants to highlight the name of the study being referred to:

SUBJECT VERB OBJECT

Results from the Twin Hearts Study showed a significant positive association between Mediterranean diet consumption and heart rate variability (HRV).

In contrast, the passive voice enables the writer to focus on the result of the action rather than on who did it:

Furthermore, a number of trials have indicated that the Mediterranean diet is associated with a 30-70% reduction in the recurrence of cardiovascular events following myocardial infarction or stroke. 2

You can see that the past passive is predominantly used in the Methods section because it is used to report a particular procedure that is finished and the focus is on the result of the action rather than on who carried it out:

Resting blood pressure values were recorded using a sphygmomanometer.

Reduced relative clauses
A further feature of scientific research reports is the multiple use of reduced relative clauses especially in the Methods, Results and Discussion. Use of such clauses helps make the writing concise. Reduced relative clauses are in the passive voice and should not be confused with the simple past tense as this example illustrates:
However, there was substantial overlap in the heart rate [that was] recorded during the second 15 seconds between the pre-diet and post-diet trials.

The verb "recorded" in the above example is a non-finite –ed participle.

In contrast, if this sentence had been written in the active voice, the verb "recorded" would be in the past tense:

The researchers recorded substantial overlap in the heart rate during the second 15 seconds between the pre-diet and post-diet trials.

Writing the above sentence in the active voice, however, would have placed unnecessary focus on those carrying out the action: the researchers.

References
