How Far Is That By Air? The Derivation Of An Air:Ground Coefficient

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Introduction
As the use of civilian aeromedical transport for EMS increases, more information is needed regarding its contribution to prehospital care. Research aimed at these goals could be facilitated with more information about the relationship between ground and helicopter transport distances. When a helicopter and an ambulance transport patients from the same location to the same hospital, the helicopter travels a shorter distance, but how much shorter is the distance? A simple equation that defines the relationship between air and ground miles would be useful to EMS personnel.

Objective
To derive a simple equation to convert distances between air and ground miles.

Methods
- We performed a retrospective analysis of a convenience sampling of 246 "Lights and Sirens" ground ambulance transports between 1993 and 1997 to the only level one trauma center in Fresno County, California.
- Ground distances were recorded from odometer miles for each transport.
- For all transports, air miles were calculated using the Global Positioning Satellite (GPS), measuring the distance in a straight line from the scene to the hospital.

Statistical Methods
- Air and ground distances were correlated using regression analysis. Analysis was done using the SPSS software.
- The derived equation was tested against a simplified approximation.

Air:Ground Mile Correlation

<table>
<thead>
<tr>
<th>Air Miles</th>
<th>Ground Miles</th>
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<tbody>
<tr>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>10</td>
<td>9.0</td>
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<tr>
<td>15</td>
<td>13.5</td>
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<tr>
<td>20</td>
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<tr>
<td>45</td>
<td>40.5</td>
</tr>
<tr>
<td>50</td>
<td>45.0</td>
</tr>
</tbody>
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- Regression equation:
  - Ground = 0.94 + 1.25 (air miles)
- Equation approximation:
  - Ground = 1.3 (air miles)

Results
- There was a strong linear correlation between ground miles and air miles at virtually all distances studied (R=0.932, R²=0.869).
- A correlation of R=0.932 is considered highly statistically significant with P<0.0005.
- Regression analysis revealed the following relationship: Ground miles = 0.94 + 1.25 (air miles).
- We simplified this to the more useful approximation: Ground miles = 1.3 (air miles).
- The approximation equation yields an answer within 1 mile of the regression equation up to a distance of 40 air miles.

Limitations
- Study design was retrospective, and data was obtained from a convenience sample. However data points were blindly selected for inclusion during the study period and distances appear to fall randomly among the data pool.
- Air travel may not always be straight line owing to airfield restrictions, barriers, etc.
- External validity must be evaluated for each EMS system. Ours is a single EMS system with a centrally located receiving hospital.
- Consideration should also be given to the unique road system and topography found in our system.
- This correlation has not been validated for extremes of distances (<3 miles or >47 miles).

Conclusions
- Knowing a 911 caller’s location by GPS, one may approximate the actual ground mileage to the hospital by multiplying the “straight line” or air distance by 1.3. This conversion coefficient may prove useful for EMS personnel in making transport decisions, conducting research or for planning purposes.

Acknowledgements
- We thank American Ambulance and SkyLife for their cooperation with and support of this study.